



rike ogden figueroa allex architect, inc.

PROJECT MANUAL

TREASURE HILLS ELEMENTARY SCHOOL -
2018-2019 ADDITIONS AND
RENOVATIONS
HARLINGEN, TX 78550
for
HARLINGEN CONSOLIDATED
INDEPENDENT SCHOOL DISTRICT
HARLINGEN, TX

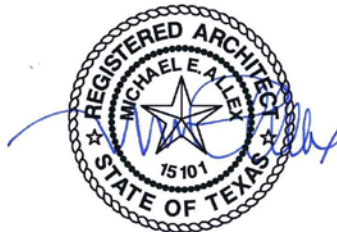
JOB: 2017.12

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HARLINGEN, TX 78550
for
HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT
HARLINGEN, TEXAS**

2017.12



5/21/2018

TEXAS BOARD OF ARCHITECTURAL EXAMINERS
333 Guadalupe, Suite 2-350, AUSTIN, TX 78701-3942
(Tel: 512/305-9000)
HAS JURISDICTION OVER INDIVIDUALS LICENSED UNDER
THE ARCHITECT'S REGISTRATION LAW
ARTICLE 249a, VERNON'S CIVIL STATUTES".

**RIKE OGDEN FIGUEROA ALLEX ARCHITECTS, INC.
1007 WALNUT AVE.
MCALLEN, TEXAS 78501
(956) 686-7771 v**

PROJECT MANUAL

**TREASURE HILLS ELEMENTARY SCHOOL
2018-2019 ADDITIONS AND RENOVATIONS
HARLINGEN ISD
HARLINGEN, TEXAS**

Project No. 2017.12

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H.C.I.S.D. Treasure Hills Elementary School
2018-2019 Classroom Additions and Renovations
Harlingen, Texas

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Date: May 21, 2018

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H.C.I.S.D. Treasure Hills Elementary School
2018-2019 Classroom Additions and Renovations
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SECTION 00020
REQUEST FOR COMPETITIVE SEALED PROPOSALS

PROJECT and PROJECT NO: CNSTXXXX-XXXX
Treasure Hills Elementary School - 2018-2019 Additions and Renovations
Harlingen, TX 78550

DUE DATE, TIME, PLACE: Tuesday, June 12, 2018 at 2:00pm
Harlingen CISD Purchasing Department
407 N. 77 Sunshine Strip
Harlingen, TX 78550
Proposal will be opened and read aloud

**PRE-PROPOSAL
CONFERENCE:** Tuesday, May 29, 2018 at 10:00am
H.C.I.S.D.'S District Operations Office
1901 N. 77 Sunshine Strip
Harlingen, Texas 78550

ARCHITECT: ROFA Architects, Inc.
1007 Walnut Ave.
McAllen, Texas 78501
Phone # 956-686-7771

Qualified offerors may obtain two (2) sets of Drawings and Project Manuals from: RGV REPROGRAPHICS 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

Subcontractors may obtain one (1) set of Drawings and Project Manuals from the office: RGV REPROGRAPHICS 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

A deposit of \$300.00 will be required for each set of Drawings and Project Manuals issued. Partial sets will not be issued. ROFA Architect, Inc.

Contractors may also obtain a digital copy of construction documents in the form of a Compact Disk. Contractors may purchase the CD for \$35.00. This purchase is non-refundable.

Both hard copies and CD's can be obtained through RGV Reprographics, 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

Deposits will be refunded to offerors and subcontractors provided that all sets along with addendums are returned within ten {10} days after date of opening of Proposals. The offeror awarded the Project may retain the Construction Documents, and request refund of deposit.

The shipping and/or postage expense of the delivery of Contract Documents shall be at the proposer's expense."

All proposals must be on a lump sum basis including General Contract, Electrical and Mechanical work. Bid security in the amount of 5% of the largest possible total of proposals submitted must accompany each proposal in accordance with the Instruction to Bidders. Performance and payment bonds for 100% of the contract value will be required upon issuance of contract.

Contract documents may be examined at the following plan rooms:

<u>A.G.C. Office</u>	<u>McGraw Hill Construction</u>	<u>Reed Construction</u>	<u>Builders Exchange</u>
Pharr, Harlingen, Brownsville	San Antonio	San Antonio	

SECTION 00030

INVITATION FOR COMPETITIVE SEALED BIDS

PART 1: GENERAL:

1.01 PROJECT DESCRIPTION:

- A. This project consists of the construction of TREASURE HILLS ELEMENTARY SCHOOL - 2018-2019 ADDITIONS AND RENOVATIONS for HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT, Harlingen, TX 78550

1.02 INSTRUCTIONS TO BIDDERS:

- A. Refer to SECTION 00100 – Instructions to Bidders

1.03 PRE-PROPOSAL CONFERENCE:

- A. The purpose of the Pre-Bid Conference is to answer any questions that any bidder may have.
- B. Date and Time: **TUESDAY, MAY 29, 2018 @ 10:00 PM**
- C. Location: **HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT – DISTRICT OPERATIONS, MAIN CONFERENCE ROOM**
1901 N. 77 SUNSHINE STRIP
HARLINGEN, TX 78550

1.04 OPENING OF BIDS:

- A. Place:
1. *Competitive sealed Bids* will be received at the **PURCHASING** office of:
- Owner:*** **HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT**
- Address:*** **407 N 77 SUNSHINE STRIP**
HARLINGEN, TX 78550
- ATTENTION: **MR. TONY GRACIA – DIRECTOR OF PURCHASING**
- B. Date: **TUESDAY, JUNE 12, 2018**
- C. Hour: **2:00 P.M.**

1.05 REJECTION:

- A. The Owner reserves the right to reject any or all Proposal, and to waive any irregularities or formalities.

END OF SECTION

SECTION 00100

ARCHITECT'S INSTRUCTIONS TO PROPOSERS

PART 1: GENERAL:

1.01 SECURITY BOND:

- A. Security bond in the amount of five percent (5%) of the Proposal must accompany each Proposal. Security bond shall be issued by an insurance company authorized to provide bonds on work in the State of Texas and shall be made payable to the Owner.

1.02 DOCUMENTS:

- A. Qualified offerors may obtain two (2) sets of Drawings and Project Manuals from: ***RGV REPROGRAPHICS 222 Hanmore Industrial, Harlingen, Texas 78550-7677 (956) 423-1520.***
- B. Subcontractors may obtain one (1) set of Drawings and Project Manuals from the office: ***RGV REPROGRAPHICS 222 Hanmore Industrial, Harlingen, Texas 78550-7677 (956) 423-1520.***
- C. A deposit of **\$300.00** will be required for each set of Drawings and Project Manuals issued. Partial sets will not be issued. Make checks payable to ROFA ARCHITECTS INC.
- D. Contractors may also obtain a digital copy of construction documents in the form of a Compact Disk. Contractors may purchase the CD for \$35.00. This purchase is non-refundable.
- E. Both hard copies and CD's can be obtained through RGV Reprographics, 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.
- F. Deposits will be refunded to offerors and subcontractors provided that all sets along with addendums are returned within ten {10} days after date of opening of Proposals. The offeror awarded the Project may retain the Construction Documents, and request refund of deposit.
- G. Deposit amount will be refunded as soon as practical, provided sets are in good condition. Costs of reproducing missing or damaged sheets or pages will be deducted from the deposit amount.
- H. Offerors may obtain additional sets by paying the cost of reproduction, which will not be refunded, and complete sets shall be returned to the Architects.
- I. Complete sets of Construction Documents shall be used in preparing proposals; neither the Owner nor the Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Construction Documents.
- J. The Owner or Architect in making copies of the Construction Documents available on the above terms, does so only for the purpose of obtaining proposals on the work and does not confer a license or grant for any other use.
- K. Complete sets of Drawings and Project Manuals are on file at the following locations and subcontractors may examine them there:

SECTION 00100
PROPOSAL INSTRUCTIONS

ROFA Architects Inc.
1007 Walnut Avenue
McAllen, Texas 78501
(956) 686-7771

McGraw-Hill Construction Dodge
<http://www.dodgeplans.construction.com>

SOUTHWEST BUILDERS EXCHANGE
4047 Naco Perrin Suit 100
San Antonio, Texas 78217
(210)564-6900

A.G.C. PLAN ROOMS
Pharr, Harlingen, Brownsville

REED CONSTRUCTION DATA
30 Technology Parkway South
Norocoroff, GA 30092
(630) 288-7959

1.03 EXAMINATION:

- A. Offerors and sub contractors shall carefully examine the Construction Documents and the construction site to familiarize themselves with existing local conditions under which the Work is to be performed.
- B. Extra payments will not be authorized for work that could have been foreseen by careful examination of the site. Submission of a proposal shall constitute acceptance, by the offeror, of existing site conditions as a part of the requirements for this work.
- C. Offerors shall carefully examine the Construction Documents to verify that they agree with the Table of Contents in the Project Manual, the Index of Drawings Sheet on the Drawings, and the Cover Page of all Addenda. Offerors shall be responsible for obtaining any pages or sheets which have been inadvertently left out during the printing process.
 - 1. All entities providing proposals on any portion of the work contained in the Construction Documents shall ascertain the completeness of the set of documents.
 - 2. The Construction Documents are printed by an independent vendor and, although the Architect endeavors to check the documents for completeness, the Architect has, in the past, discovered missing or misplaced sheets in the Drawings and the Specifications.
 - 3. Each entity receiving a set of Construction Documents shall check the indexes against the sheets or pages contained in the sets.
 - 4. Should pages or sheets be found to be misplaced or missing, immediately notify the Architect who will give direction as to placement or provide the sheets or pages that are missing.
 - 5. Failure to notify the Architect means the offeror is providing a proposal based on a complete set of Construction Documents.

1.04 INTERPRETATION OF CONSTRUCTION DOCUMENTS:

- A. Offerors shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover upon examination of the Construction Documents or of the site and local conditions.
- B. Submit all questions regarding clarification or interpretation of Construction Documents to the Office of the Architects: ROFA ARCHITECTS, INC., 1007 Walnut Avenue, McAllen, TX 78501. (*Attn: MICHAEL ALLEX, AIA – email address - mikea@rofainc.com*).
- C. Submit all questions in writing. In the interest of time, requests may be made by telephone, but they must be submitted in writing the same day. Replies to questions will be issued to all Offerors in the form of an Addenda. General contractor and subcontractors shall submit questions in writing forty eight (48) hours prior to opening of proposals.
- D. Make requests for interpretations as early as possible so as to allow adequate time to prepare and issue Addenda.
- E. All Offerors shall check with the Architect within **six (6) hours** prior to Opening of proposals to secure all

SECTION 00100
PROPOSAL INSTRUCTIONS

Addenda. The Architect will not be responsible for oral clarification.

1.05 BASIS OF PROPOSALS:

- A. Proposals shall be on a lump sum basis for each and or combined proposal packages and shall include all costs for these projects as described and indicated by the Construction Documents. Basis for proposals shall be on brands, materials, processes, products, persons or organizations, etc., indicated in the Construction Documents.
- B. Proposals shall include all unit price costs and all Alternate costs as indicated by the Construction Documents and Proposal Form.

1.06 ALTERNATES:

- A. The Owner may, at his option, elect to proceed with any or all Alternates as set forth in the Contract Requirements.
- B. Amount shown in proposal for each Alternate shall include profit, insurance, contingencies and other costs incidental to performance under such Alternative.
- C. Amount shown in Proposal for each Alternate shall include the making of all changes and the installation of all materials and equipment necessary to the accomplishment of the Alternate requirements.

1.07 SUBSTITUTIONS:

- A. Approval Required:
 - 1. The Contract is based on the standards of quality established in the Contract Documents.
 - 2. All products proposed for use, including those specified by required attributes and performance, shall require approval by the Architect before being incorporated into the work.
 - 3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the Architect.
 - 4. Product substitution requests shall be submitted no later than 72 hours prior to Opening of Bids (Proposals) as noted in Section 00020.

1.08 PROPOSALS:

- A. Proposals shall be made on unaltered Proposal Forms furnished by the Architect. No oral, telephone or personal Proposals will be considered. All blank spaces shall be properly filled in by typewriter or manually in ink.
- B. Where so indicated by the makeup of the Proposal Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the written amount shall govern.
- C. Any alteration or erasure to information entered in the blank spaces must be initialed by the signer of the proposal.
- D. Original sheets shall be submitted, signed in longhand below the printed name of the person authorized to bind the offeror to a Contract.
- E. Where offeror is a corporation, Proposal must be signed with the legal name of the corporation followed by the name of the State of Incorporation and the legal signature of a person authorized to bind the corporation to a Contract.
- F. Failure to submit a proposal on the form requested, or the inclusion of conditions, limitations or provisions

SECTION 00100
PROPOSAL INSTRUCTIONS

distorting the intent of the Construction Documents, will render the proposal irregular and subject to rejection.

1.09 SUBMITTALS:

- A. Submit Proposal, Security Bond and other required data in an opaque, sealed envelope. Submit proposal at the time and place shown in the *Invitation for Competitive Sealed Proposals*
- B. Envelope shall be addressed to the Owner and identified with the Project Name and the name and address of the offeror.
- C. If the Proposal is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "PROPOSAL ENCLOSED" on the face thereof. No envelopes shall be opened until the date and time proposals are to be received.

1.10 MODIFICATION OR WITHDRAWAL OF PROPOSAL:

- A. A proposal may not be withdrawn or canceled by the offeror during the stipulated time period following the time and date designated for the receipt of Proposals, unless the award of Contract has been delayed more than sixty (60) calendar days.
- B. Prior to the time and date designated for receipt of Proposals, Proposals submitted early may be modified or withdrawn only by notice to the party receiving Proposals at the place and prior to the time designated for receipt of Proposals.
- C. Modification of Proposals shall be in writing over the signature of the offeror or be by telegram; if by telegram, written confirmation over the signature of offeror must have been mailed and postmarked on or before the date and time set for receipt of proposals; it shall be so worded as not to reveal the amount of the original Proposal.
- D. Withdrawn Proposal may be resubmitted up to the time designated for the receipt of proposals provided that they are then fully in conformance with these Proposal Instructions.
- E. Security bond shall be in an amount sufficient for the proposal as modified or resubmitted.

1.11 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 Owner* provided the Proposal has been submitted in accordance with the requirements of the Contract Documents and selection criteria adopted by the Owner..
- F. *Contractor shall provide supplemental information to address selection criteria noted in Section 00320 Ranking/Selection Criteria. The support information will not be disclosed to other offerors.*
- G. *The estimated budget is as follows: \$10,000,000.*

1.12 LOCATION TO ACCESS AND PREMISES:

- A. The project site location: *Refer to vicinity map on drawings.*

SECTION 00100
PROPOSAL INSTRUCTIONS

- 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. Offeror shall cooperate with the other contractors who may concurrently be working on the premises, integrating his work with that of others, all to the best interest of the total work and its orderly completion.

1.13 STATE SALES TAX:

- A. *This project is exempt from state taxes. A sales tax exemption certificate may be obtained from the State Comptroller.*

END OF SECTION

SECTION 00101

Harlingen CISD Instructions to Proposers

**HARLINGEN CONSOLIDATED
INDEPENDENT SCHOOL DISTRICT**



**407 N. 77 Sunshine Strip
Harlingen, TX 78550**

Request for Competitive Sealed Proposals

**Harlingen CISD 2018 – 2020 Renovations and
Additions to Treasure Hills Elementary School
CNST 0618-2**

Due: Tuesday, June 12, 2018 @ 2:00 PM

Advertisement

**Harlingen Consolidated Independent School District
REQUEST FOR COMPETITIVE SEALED PROPOSALS**

PROJECT and PROJECT NO: CNST 0618-2
Harlingen CISD Treasure Hills Elementary School – 2018 – 2019 Additions and Renovations

DUE DATE, TIME, AND PLACE: Tuesday, June 12, 2018 @ 2:00 PM
Harlingen CISD Purchasing Department
407 N. 77 Sunshine Strip
Harlingen, TX 78550
Proposal will be opened and read aloud.

PRE-PROPOSAL CONFERENCE: Tuesday, May 29, 2018 @ 10:00 AM
HCISD'S District Operations Office
1901 N. 77 Sunshine Strip
Harlingen, Texas 78550

ARCHITECT: ROFA Architects, Inc.
1007 Walnut Ave.
McAllen, Texas 78501
Phone # 956-686-7771

Qualified offerors may obtain two (2) sets of Drawings and Project Manuals from: RGV REPROGRAPHICS 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

Subcontractors may obtain one (1) set of Drawings and Project Manuals from the office: RGV REPROGRAPHICS 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

A deposit of \$300.00 will be required for each set of Drawings and Project Manuals issued. Partial sets will not be issued. ROFA Architect, Inc.

Contractors may also obtain a digital copy of construction documents in the form of a Compact Disk. Contractors may purchase the CD for \$35.00. This purchase is non-refundable.

Both hard copies and CD's can be obtained through RGV Reprographics, 519 South Broadway, McAllen, Texas 78501 (956) 686 – 1525.

Deposits will be refunded to offerors and subcontractors provided that all sets along with addendums are returned within ten {10} days after date of opening of Proposals. The offeror awarded the Project may retain the Construction Documents, and request refund of deposit.

The shipping and/or postage expense of the delivery of Contract Documents shall be at the proposer's expense."

All proposals must be on a lump sum basis including General Contract, Electrical and Mechanical work. Bid security in the amount of 5% of the largest possible total of proposals submitted must accompany each proposal in accordance with the Instruction to Bidders. Performance and payment bonds for 100% of the contract value will be required upon issuance of contract.

Contract documents may be examined at the following plan rooms:

A.G.C. Office
Harlingen
McAllen
Brownsville

McGraw Hill Construction Reed Construction
San Antonio San Antonio

Builders Exchange
San Antonio

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I. INTRODUCTION

A. **INVITATION TO PROVIDE COMPETITIVE SEALED PROPOSAL**

Pursuant to the requirements of Texas Government Code Chapter 2269, Subchapter D, the Harlingen Consolidated Independent School District (hereafter HCISD) invites your Competitive Sealed Proposals for furnishing the merchandise, supplies, equipment, and labor set forth in this Request for Competitive Sealed Proposals (CSP).

PROJECT and PROJECT NO: CNST 0618-2
Harlingen CISD Treasure Hills Elementary School – 2018 – 2019
Additions and Renovations

DUE DATE, TIME, AND PLACE: Tuesday, June 12, 2018 @ 2:00 PM
Harlingen CISD Purchasing Department
407 N. 77 Sunshine Strip
Harlingen, TX 78550
Proposal will be opened and read aloud.

PRE-PROPOSAL CONFERENCE: Tuesday, May 29, 2018 @ 10:00 AM
HCISD'S District Operations Office
1901 N. 77 Sunshine Strip
Harlingen, Texas 78550

ARCHITECT: ROFA Architects, Inc.
1007 Walnut Ave.
McAllen, Texas 78501
Phone # 956-686-7771

HCISD will only accept HARD COPY of SEALED PROPOSAL Package; therefore faxes and/or e-mails will not be accepted under any circumstances.

B. **INSTRUCTIONS TO PROPOSER**

1. Completed Sealed Proposal documents must be received in the Purchasing Department of the Harlingen Consolidated Independent School District-Purchasing Department, 407 N. 77 Sunshine Strip, Harlingen, Texas 78550 on or before 2:00 P.M. of the "OPENING DATE" at which time proposals will be accepted. Proposals will be Opened and Read Aloud right after due time. *LATE* proposals will not be accepted and will be returned to the proposer unopened. **PLEASE MARK FRONT SIDE OF SEALED ENVELOPE WITH PROPOSAL NAME AND NUMBER AND OPENING DATE AND TIME AS INDICATED.**

2. *Proposals may be withdrawn at any time prior to the due date and time. Should any changes be made to original submittal then Proposer guaranteeing authenticity must initial ANY AND ALL alterations made thereon on any submission documents. After the official due time, proposals may not be amended, altered, or withdrawn. The District reserves the right to request clarification(s) with any proposer.*

3. The undersigned agrees, if their proposal is accepted, to furnish any and all items upon the terms and conditions contained in the specifications. If the proposer fails to fulfill any and all contractual obligations resulting from their proposal submittal, then the Uniform Commercial Code shall govern. Vendors are requested to hold *proposal offers* firm for period of forty-five (45) days from the due date for acceptance. Should vendors specify a different time period; consideration for overall acceptance will be evaluated based on any and all factors, to ensure the interest to HCISD, and fairness to all respondents.

4. Please note the attached terms, conditions, or specifications to this solicitation. All proposals must be submitted in the HCISD format provided, and in accordance with specifications and descriptions on the proposal sheets. This Request for Proposal Package is CNST 0618-2

Harlingen CISD Treasure Hills Elementary School – 2018 – 2019 Additions and Renovations

5. By submitting a Proposal, each Proposer agrees to waive any claim it has or may have against HCISD, its trustees, agents and employees, and any reference sources, arising out of or in connection with the administration, evaluation, or recommendation of any Proposal; waiver of any requirements under the proposal documents; acceptance or rejection of any Proposal; and award of a contract. The District shall have no contractual obligation to any Proposer, nor will any Proposer have any property interest or other right in the Proposal or contract being proposed unless and until the contract is unconditionally executed and delivered by all parties, and all conditions to be fulfilled by the Proposer have been fulfilled by the Proposer.

6. THE PROPOSAL SIGNATURE PAGE 29 (SECTION N) MUST BE SIGNED AND EXECUTED BY A PERSON DULY AUTHORIZED TO LEGALLY BIND SAID COMPANY TO ANY AND ALL SPECIFICATIONS EXPRESSED AND IMPLIED AND GOVERNED BY UCC CODE. FAILURE TO SIGN FORM WILL RESULT IN REJECTION OF PROPOSAL IN ITS ENTIRETY.

C. GENERAL TERMS AND CONDITIONS

1. Submittal shall be inclusive of any and all delivery charges for products and services as may be required to complete 100% of the awarded contract.

2. Tele-faxed and/or e-mail proposals will NOT be accepted.

3. Samples may be requested for testing by HCISD for evaluation. Samples not deemed meeting criteria OR MEETING SPECIFIC INTENDED PURPOSE with regards to workmanship or performance to design specifications shall be considered *non-conforming*, and will be sufficient reason to reject or disqualify your proposal. Samples not submitted within the time frame established will automatically DISQUALIFY the proposal.

4. All prices/discounts must be guaranteed through the contract period, or fulfillment of resulting contract. Any and all discounts must be inclusive in proposal unit price.

5. Specifications, as written meet specific requirements for standardization and performance reliability of application. Submittals (offers) different from the original requirements must meet or exceed original proposal specifications to be considered as equivalent and as stated within the technical specifications. It is a mandatory requirement of these specifications, in order to qualify alternate (equal) products to those specifically named; that, complete material/product specification-data sheets to be provided with the sealed proposal package. Additionally, Proposer shall include product performance information to demonstrate product performance compatibility with specifications as written. Failure to provide/ include when offering an alternate product shall be sufficient grounds for disqualification. Failure to abide by any time frames as required within the specifications shall also be sufficient grounds for disqualification. Any other deviation such as performance or feature shall be stated by separate attachment.

6. Within the specification a performance standard might be established by use of a proprietary (Registered) trade name or by use of a manufacturer or brand name, the term “**OR EQUAL**,” if not inserted, ***SHALL BE IMPLIED***. The specified article or material shall be understood as indicating the type, function, minimum standard of design, efficiency and quality desired, and shall not be construed as to exclude other manufactured products of comparable or superior quality, design, and efficiency. **Further, the products named herein have demonstrated satisfactory performance outcomes in actual application setting. HCISD will reserve the right to request product samples that will be subject to test and evaluate in our actual environment to determine performance characteristics in our application environment.**

“OR EQUAL” INTERPRETATION CLAUSE: Any time a particular manufacturers’ name or brand is

specified, it shall mean any product of equal or superior quality. Proposals shall be considered on all other brands submitted of equal or superior quality and performance. On such proposal items the proposer shall indicate clearly the product name on which he is proposing, and shall supply sufficient data on brand or manufacturer specified in concert with specifications assembled by the Engineer/Architect in a direct one to one comparison of all values as provided by the basis of design. When more than one brand name of the "or equal" is available, do not propose more than *two* item choices. *THE DISTRICT RESERVES THE RIGHT TO A FINAL DECISION OF ANY PRODUCT STATED TO BE OF EQUAL OR SUPERIOR QUALITY.*

7. After Award of Contract is made, product substitution of item(s) as proposed and accepted will not be allowed.

8. Patented or Copyright Protected Items: The fact that a particular item is covered by a patent or copyright does not automatically mean that the purchase falls under the provisions pertaining to exemptions from the competitive bidding requirements for items available from only one source. In fact, nearly all consumer goods are covered by patents. To be a bona fide exemption to the competitive bidding requirement, there must be no other like items available for purchase that would serve the same purpose or function, and only one price for the product because of exclusive distribution or marketing rights. In the event any article to be sold or delivered hereunder is covered by any patent, copyright, trademark, or application thereof, the seller shall indemnify and hold harmless the district from any and all loss, cost, expenses, and legal fees on account of manufacture, sale, or use of such articles in violation of infringement or the lack of rights under such patent, copyright, trademark, or application.

9. During the performance of this contract, the vendor agrees not to discriminate against any employee or applicant for employment because of race, color, national origin, age, religion, gender, marital or veteran status, or disabled condition. Contractor shall comply with all sections as further defined in Texas Government Code Section 2269.054

10. Not Used.

11. Merchandise received shall be newly manufactured merchandise. Refurbished or reconditioned merchandise will not be allowed. Merchandise discovered not in new condition will be returned freight collect at the vendors' expense. If the problem is not corrected within ten (10) working days of notification the HCISD, will have the right to recourse and seek remedy.

12. Warranty: A minimum warranty period as further delineated in the specifications shall be provided on all materials and workmanship. In the event of failure, the vendor agrees to replace such units at no cost to the district within ten (10) working days.

13. Not Used.

14. Respondents shall restrict all contact with the Owner and direct all questions regarding this solicitation, including questions regarding terms and conditions, to the District's Representatives identified in Section II.D by email. **Do not contact members of the Board of Trustees or other employees of the School District, Contact with any of these prohibited individuals after issuance of this solicitation and before selection is made, may result in disqualification of your submittal.**

15. The following documents are required to be completed and enclosed with your proposal. Failure to include all documents shall be grounds for disqualification. The District shall reserve the right to wave minor technicalities as it deems appropriate.

16. During the performance of any contract, contractor's employee and subcontractors shall acknowledge and comply with all Federal, State, Local Policy, and Directives of the HCISD. The work

is to be performed on campus location where **the use of any tobacco product is strictly prohibitive** by law. Contractor's employees or employees of subcontractors will be required to wear proper attire and shall be required to wear proper identification tags at all times.

17. Any and all employees will be required to provide a State or Federal issued picture identification, and as required comply with criminal background checks.

18. Any person participating in the Pre-Bid Walk-Through will be required to present a State or Federal issued picture identification. Said ID will be used to clear employee background at one or all locations to be visited.

19. Should an instructional program be on going during the execution of the resulting contract, the Contractor will be required to comply and abide HCISD instruction so interruption of the instructional program is not impeded – www.hcisd.org/testingdates .

20. Proposer will include one (1) original proposal and three (3) copies.

21. Construction improvements shall be performed during normal business hours as allowed by close coordination with campus principals. Contractor shall expect to work after hours until 11:00pm. After hours work will be closely coordinated with HCISD personnel.

22. The project budget is estimated to be \$11,000,000 (base bid) and The Undersigned agrees to commence work within ten (10) days of Notice to Proceed, WHICH WILL BE NO LATER THAN MONDAY, JULY 2, 2018, and to be substantially complete with the work within 365 CALENDAR DAYS.

23. Proposal form can be found in Section 00310 of The Architect's Specifications.

DOCUMENTS REQUIRED TO BE COMPLETED AND RETURNED WITH SUBMITTAL

D. RANKING CRITERIA & DELAGATION OF AUTHORITY TO RANKING COMMITTEE

The Harlingen Consolidated Independent School District is soliciting Competitive Sealed Proposals as defined in Texas Local Government Code Chapter 2269 and all related Sections thereof. Proposals shall be received evaluated and ranked by the Ranking Committee in accordance with Board approved ranking criteria and associated weights. The Ranking Criteria is hereby furnished below. Proposers shall provide responses to all criterion as specifically requested.

**BOARD APPROVED
DELEGATION OF AUTHORITY TO EVALUATION COMMITTEE,
EVALUATION CRITERIA, AND RELATIVE WEIGHTS**

DELEGATION

The Harlingen Consolidated Independent School District's Board of Trustees has set forth as mandated by Government Code 2269.053 the Delegation of Authority to the following committee members to evaluate and rank Offerors for selection of a construction company. Further, as mandated by 2269.056, the Board having determined the construction method "Competitive Sealed Proposals" as the method for soliciting proposals establishes the evaluation criteria and associated weights as follows:

RANKING COMMITTEE MEMBERS:

Chief Financial Officer
Assistant Superintendent for District Operations
Director of Purchasing
Construction Manager
Project Consultant

EVALUATION CRITERIA

The evaluation criterion as outlined below has been approved by the HCISD's Board of Trustees. The committee will evaluate and rank each Offeror based on the published criteria and relative weights. The Committee or representative thereof will then proceed to negotiate a contract with the highest-ranking offeror. If negotiations are unsuccessful, the District will notify said offeror that negotiations have been terminated and will proceed to negotiate with the next highest ranked Offeror. The district will continue this process until a contract has been reached. The District reserves the right to exclude firms failing to achieve a minimum total score from any further consideration for negotiation. Upon negotiation of a successful contract the committee will present such evidence of finding to the Board, which will retain the right to award the committee's recommendation or reject all bids in their entirety.

CRITERIA/RELATIVE WEIGHTS

The District retains the right to apply any or all selection criteria noted in Government Code 2269.055, including but not limited to, as provided by section 2269.055 (8), "any other relevant factor". Offerors are to provide complete and specific information as requested to all items of the Ranking/Selection criteria. Non-responses to any item(s) will result in zero (0) points awarded. The relative weights (points) for each criterion are noted; award of points is dependent on the merits and completeness of information provided.

Ranking Criteria and Associated Weights

Construction Experiences:

Points Item

- | | | |
|-------|----|--|
| 10 | 1. | <p>Please provide a list of projects your company has constructed which are of similar Size, Type and Complexity to this project. Please list in chronological sequence beginning with most recent. For those projects constructed within the last 5 years and which meet the criteria, please denote the following information:</p> <p>Owner's; Name, address, Contact name, telephone number, email address, year
Project was completed
(HCISD will reserve the right to call all owners listed to solicit references)
Criteria #2 and #3 are reserved for the District and the assigned Consultant to assess points based but not limited to: job performance, quality of work, meeting timelines, efforts towards overcoming delays, professionalism, project closeouts, bill payment history, change order pricing, and job safety. A points range as shown below for each criterion is possible for those with past experience with HCISD, and 0 points for not having experience directly with HCISD.</p> |
| -5 +5 | 2. | <p>District's assessment of past experience with contractor, contractors with no experience with the district receive zero points.</p> |
| -3 +3 | 3. | <p>Assigned project Consultant's assessment of past experience with contractor</p> |
| 4 | 4. | <p>How long has your organization been in the construction business, under the same management?
(Minimum 5 years of comparable construction experience required for max points)</p> |
| 3 | 5. | <p>Provide a narrative describing your company's approach to employee safety. Include a copy of the published Company's Safety policy.</p> |
| 3 | 6. | <p>Provide a list of awards your firm has received.</p> |

Reference(s) from Owners for Past Performances:

Provide three (3) OWNER references (other than HCISD) from Projects listed on item 1, and completed within the last five years. Provide complete information as requested on the attached form, failure to provide current contact information may disqualify point assignment. The following points will be awarded based on the merits of the information provided by your references.

For items 7 - 18 please complete attached Owner's Reference Form and include with Proposal Submittal

- | | | |
|---|-----|--|
| 3 | 7. | Overall quality of the work |
| 2 | 8. | Performed and completed punch list items timely |
| 2 | 9. | Provided completed warranty documents and performed warranty items timely |
| 3 | 10. | Contractor's history of completing on schedule |
| 2 | 11. | Contractor's cooperative attitude when working with the owner's in resolving construction issues |
| 2 | 12. | Contractor's diligence in providing detailed documentation and a fair assessment of change order pricing |
| 2 | 13. | Would this contractor be your first choice on your future projects? |

Reference(s) from Architect for Past Performances:

Provide contact information from an Architectural Firm (other than assigned firm to this project) who will provide references to the following points on your behalf. Your firm must have completed a project with said firm within the last three years. Provide complete information as requested, failure to provide current contact information may disqualify points. The following points will be awarded based on the merits of the information provided.

- 3 14. Overall quality of the work
- 2 15. Completed punch list items and provided warranty documents timely
- 3 16. Contractor's history of completing on schedule
- 2 17. Contractor's cooperative attitude in resolving construction issues
- 2 18. Contractor's diligence in providing detailed documentation and a fair assessment of
change order pricing

Key Personnel:

Provide completed resume(s) of the key supervisory personnel to be assigned to this project. Resumes must include references with names and telephone numbers for District verification. Please note HCISD will reserve the right to call listed references. Key personnel should have demonstrated ample experience on projects of similar size and complexity. Points are to be assigned on the merits of the proposed personnel, no substitutions will be allowed if awarded contract

- 3 19. Project Manager
- 3 20. Onsite Project Superintendent
- 6 21. Provide a complete list of all subcontractors to be used on this project.
(The list will be due within 24 hours of the bid due date and time, and at the same location as bid)

Financial Strength:

Please provide the following documents addressing each of the following; documents should be dated within the last 12 months or timeline as requested:

- 6 22. Provide a financial statement to include Balance Sheet and Operating Statement dated within the last 24 months-required.
- 4 23. Please provide information from your Performance and Payment Bonding Company with regards to your bonding capacity.

Price:

- 50 24. The lowest monetary offer to the base bid will receive the maximum 50 points.
In case of ranking points tie the lowest monetary base bid submitted will be considered the highest ranking Offeror.

Harlingen Consolidated Independent School District

407 N. 77 Sunshine Strip

Harlingen, TX 78550

P: (956)430-9740

F: (956)430-9796

References from Owners and Architect for Past Performances

Response for Ranking Criteria Items #7 – 13

Name of Entity _____

Name of Person to Contact for Reference: _____

Address for Contact Person _____

Telephone Number _____

Email Address: _____

List Specific Project(s) Constructed: _____

Name of Entity _____

Name of Person to Contact for Reference: _____

Address for Contact Person _____

Telephone Number _____

Email Address: _____

List Specific Project(s) Constructed: _____

Name of Entity _____

Name of Person to Contact for Reference: _____

Address for Contact Person _____

Telephone Number _____

Email Address: _____

List Specific Project(s) Constructed: _____

Response for Ranking Criteria Item #14 - 18

Name of Architect Firm: _____

Name of Person to Contact for Reference: _____

Address for Contact Person _____

Telephone Number _____

Email Address: _____

List Specific Project(s) Constructed: _____

If necessary, please use additional pages

E. NON-COLLUSION STATEMENT

The undersigned affirms that he/she is duly authorized to execute this contract, that this company, corporation, firm, partnership or individual has not prepared this proposal in collusion with any other Proposer, and that the contents of this proposal as to prices, terms or conditions of said proposal have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business, or to any individual affiliated with Harlingen Consolidated Independent School District prior to the official opening of this proposal.

NOTIFICATION OF CRIMINAL HISTORY OF CONTRACTOR

Texas Education Code Section 44.034 states: "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."

I, the undersigned authorized agent for the company named below; certify that I have complied with the procedures outlined above.

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE _____

AREA CODE/FAX _____

E-MAIL ADDRESS _____

SIGNATURE

TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

F. CERTIFICATE OF RESIDENCY

Texas Government Code Chapter 2252, Subchapter A. makes it necessary to determine the residency of bidders. In part, this law reads as follows:

Section 2252.001 (3): "Non-resident Bidder" refers to a person who is not a resident of this state. (4): "Resident Bidder" refers to a person, whose principal place of business is in this state, including a Bidder or Contractor whose ultimate parent company majority owner has its principal place of business in this state.

Section 2252.002: "A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident bidder underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresidents principal place of business is located."

I certify that

Name of Bidding Co

Is, under Section 2252.001 (3) and (4), a

Please check one:

_____ Resident Bidder or _____ Non-Resident Bidder

My/our principal place of business under Section 2252.001 (3) and (4), is in the city of

In _____ the state of _____.

(a) Does your "Resident State" require bidders whose principal place of business is in Texas to underbid bidders whose residence state is the same as yours by a prescribed amount or percentage to receive a comparable contract? _____ Yes _____ No

(b) If yes, what is amount of the percentage? _____ %

Signature of Authorized Company Official

Date

Printed Name of Official

Title/Position of Company Official

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

G. CRIMINAL BACKGROUND CHECK

Contractor must comply with Texas Education Code 22.0834, Criminal History Record information Review of Certain Contract Employees. Before work on this contract begins, Contractor shall obtain criminal history record information through the criminal history clearinghouse as provided by Section 411.0845, Government Code relating to an employee or applicant who has or will have continuing duties related to the contracted services and the employee or applicant has or will have direct contact with students. The Contractor must obtain criminal history record information before or immediately after employing or securing the services of the employee or applicant that has or will have continuing duties related to the contracted services if the employee or applicant has or will have direct contact with students. The Contractor further agrees that he shall assume all expenses associated with the criminal background check and shall immediately remove any employee or agent who was convicted of a felony, or misdemeanor as defined by Texas law, from District property or the location where students are present.

I, the undersigned authorized agent for the company named below; certify that I have complied with the procedures outlined above.

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE _____

AREA CODE/FAX _____

E-MAIL ADDRESS _____

SIGNATURE

TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

H. W-9 FORM

Form W-9 (Rev. January 2011) Department of the Treasury Internal Revenue Service	Request for Taxpayer Identification Number and Certification	Give Form to the requester. Do not send to the IRS.
Print or type See Specific Instructions on page 2.	Name (as shown on your income tax return)	
	Business name/disregarded entity name, if different from above	
	Check appropriate box for federal tax classification (required): <input type="checkbox"/> Individual/sole proprietor <input type="checkbox"/> C Corporation <input type="checkbox"/> S Corporation <input type="checkbox"/> Partnership <input type="checkbox"/> Trust/estate	
	<input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶	
	<input type="checkbox"/> Other (see instructions) ▶	
Address (number, street, and apt. or suite no.)		Requester's name and address (optional)
City, state, and ZIP code		
List account number(s) here (optional)		
Part I Taxpayer Identification Number (TIN) Enter your TIN in the appropriate box. The TIN provided must match the name given on the "Name" line to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see <i>How to get a TIN</i> on page 3.		
Social security number <div style="border: 1px solid black; width: 100px; height: 20px; margin: 5px 0;"></div>		Employer identification number <div style="border: 1px solid black; width: 150px; height: 20px; margin: 5px 0;"></div>
Part II Certification Under penalties of perjury, I certify that:		
1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and		
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and		
3. I am a U.S. citizen or other U.S. person (defined below).		
Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 4.		
Sign Here	Signature of U.S. person ▶	
	Date ▶	
General Instructions Section references are to the Internal Revenue Code unless otherwise noted.		
Purpose of Form A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA. Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:		
1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),		
2. Certify that you are not subject to backup withholding, or		
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.		
Note. If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9. Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are: • An individual who is a U.S. citizen or U.S. resident alien, • A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States, • An estate (other than a foreign estate), or • A domestic trust (as defined in Regulations section 301.7701-7). Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign person, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.		

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:

- The U.S. owner of a disregarded entity and not the entity,
- The U.S. grantor or other owner of a grantor trust and not the trust, and
- The U.S. trust (other than a grantor trust) and not the beneficiaries of the trust.

Foreign person. If you are a foreign person, do not use Form W-9. Instead, use the appropriate Form W-8 (see Publication 515, *Withholding of Tax on Nonresident Aliens and Foreign Entities*).

Nonresident alien who becomes a resident alien. Generally, only a nonresident alien individual may use the terms of a tax treaty to reduce or eliminate U.S. tax on certain types of income. However, most tax treaties contain a provision known as a "saving clause." Exceptions specified in the saving clause may permit an exemption from tax to continue for certain types of income even after the payee has otherwise become a U.S. resident alien for tax purposes.

If you are a U.S. resident alien who is relying on an exception contained in the saving clause of a tax treaty to claim an exemption from U.S. tax on certain types of income, you must attach a statement to Form W-9 that specifies the following five items:

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.
2. The treaty article addressing the income.
3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.
4. The type and amount of income that qualifies for the exemption from tax.
5. Sufficient facts to justify the exemption from tax under the terms of the treaty article.

Example. Article 20 of the U.S.-China income tax treaty allows an exemption from tax for scholarship income received by a Chinese student temporarily present in the United States. Under U.S. law, this student will become a resident alien for tax purposes if his or her stay in the United States exceeds 5 calendar years. However, paragraph 2 of the first Protocol to the U.S.-China treaty (dated April 30, 1984) allows the provisions of Article 20 to continue to apply even after the Chinese student becomes a resident alien of the United States. A Chinese student who qualifies for this exception (under paragraph 2 of the first protocol) and is relying on this exception to claim an exemption from tax on his or her scholarship or fellowship income would attach to Form W-9 a statement that includes the information described above to support that exemption.

If you are a nonresident alien or a foreign entity not subject to backup withholding, give the requester the appropriate completed Form W-8.

What is backup withholding? Persons making certain payments to you must under certain conditions withhold and pay to the IRS a percentage of such payments. This is called "backup withholding." Payments that may be subject to backup withholding include interest, tax-exempt interest, dividends, broker and barter exchange transactions, rents, royalties, nonemployee pay, and certain payments from fishing boat operators. Real estate transactions are not subject to backup withholding.

You will not be subject to backup withholding on payments you receive if you give the requester your correct TIN, make the proper certifications, and report all your taxable interest and dividends on your tax return.

Payments you receive will be subject to backup withholding if:

1. You do not furnish your TIN to the requester,
2. You do not certify your TIN when required (see the Part II instructions on page 3 for details),
3. The IRS tells the requester that you furnished an incorrect TIN,
4. The IRS tells you that you are subject to backup withholding because you did not report all your interest and dividends on your tax return (for reportable interest and dividends only), or
5. You do not certify to the requester that you are not subject to backup withholding under 4 above (for reportable interest and dividend accounts opened after 1983 only).

Certain payees and payments are exempt from backup withholding. See the instructions below and the separate Instructions for the Requester of Form W-9.

Also see *Special rules for partnerships* on page 1.

Updating Your Information

You must provide updated information to any person to whom you claimed to be an exempt payee if you are no longer an exempt payee and anticipate receiving reportable payments in the future from this person. For example, you may need to provide updated information if you are a C corporation that elects to be an S corporation, or if you no longer are tax exempt. In addition, you must furnish a new Form W-9 if the name or TIN changes for the account, for example, if the grantor of a grantor trust dies.

Penalties

Failure to furnish TIN. If you fail to furnish your correct TIN to a requester, you are subject to a penalty of \$50 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

Civil penalty for false information with respect to withholding. If you make a false statement with no reasonable basis that results in no backup withholding, you are subject to a \$500 penalty.

Criminal penalty for falsifying information. Willfully falsifying certifications or affirmations may subject you to criminal penalties including fines and/or imprisonment.

Misuse of TINs. If the requester discloses or uses TINs in violation of federal law, the requester may be subject to civil and criminal penalties.

Specific Instructions

Name

If you are an individual, you must generally enter the name shown on your income tax return. However, if you have changed your last name, for instance, due to marriage without informing the Social Security Administration of the name change, enter your first name, the last name shown on your social security card, and your new last name.

If the account is in joint names, list first, and then circle, the name of the person or entity whose number you entered in Part I of the form.

Sole proprietor. Enter your individual name as shown on your income tax return on the "Name" line. You may enter your business, trade, or "doing business as (DBA)" name on the "Business name/disregarded entity name" line.

Partnership, C Corporation, or S Corporation. Enter the entity's name on the "Name" line and any business, trade, or "doing business as (DBA)" name on the "Business name/disregarded entity name" line.

Disregarded entity. Enter the owner's name on the "Name" line. The name of the entity entered on the "Name" line should never be a disregarded entity. The name on the "Name" line must be the name shown on the income tax return on which the income will be reported. For example, if a foreign LLC that is treated as a disregarded entity for U.S. federal tax purposes has a domestic owner, the domestic owner's name is required to be provided on the "Name" line. If the direct owner of the entity is also a disregarded entity, enter the first owner that is not disregarded for federal tax purposes. Enter the disregarded entity's name on the "Business name/disregarded entity name" line. If the owner of the disregarded entity is a foreign person, you must complete an appropriate Form W-8.

Note. Check the appropriate box for the federal tax classification of the person whose name is entered on the "Name" line (Individual/sole proprietor, Partnership, C Corporation, S Corporation, Trust/estate).

Limited Liability Company (LLC). If the person identified on the "Name" line is an LLC, check the "Limited liability company" box only and enter the appropriate code for the tax classification in the space provided. If you are an LLC that is treated as a partnership for federal tax purposes, enter "P" for partnership. If you are an LLC that has filed Form 8832 or a Form 2553 to be taxed as a corporation, enter "C" for C corporation or "S" for S corporation. If you are an LLC that is disregarded as an entity separate from its owner under Regulation section 301.7701-3 (except for employment and excise tax), do not check the LLC box unless the owner of the LLC (required to be identified on the "Name" line) is another LLC that is not disregarded for federal tax purposes. If the LLC is disregarded as an entity separate from its owner, enter the appropriate tax classification of the owner identified on the "Name" line.

Other entities. Enter your business name as shown on required federal tax documents on the "Name" line. This name should match the name shown on the charter or other legal document creating the entity. You may enter any business, trade, or DBA name on the "Business name/disregarded entity name" line.

Exempt Payee

If you are exempt from backup withholding, enter your name as described above and check the appropriate box for your status, then check the "Exempt payee" box in the line following the "Business name/disregarded entity name," sign and date the form.

Generally, individuals (including sole proprietors) are not exempt from backup withholding. Corporations are exempt from backup withholding for certain payments, such as interest and dividends.

Note. If you are exempt from backup withholding, you should still complete this form to avoid possible erroneous backup withholding.

The following payees are exempt from backup withholding:

1. An organization exempt from tax under section 501(a), any IRA, or a custodial account under section 403(b)(7) if the account satisfies the requirements of section 401(f)(2).
 2. The United States or any of its agencies or instrumentalities,
 3. A state, the District of Columbia, a possession of the United States, or any of their political subdivisions or instrumentalities,
 4. A foreign government or any of its political subdivisions, agencies, or instrumentalities, or
 5. An international organization or any of its agencies or instrumentalities.
- Other payees that may be exempt from backup withholding include:
6. A corporation,
 7. A foreign central bank of issue,
 8. A dealer in securities or commodities required to register in the United States, the District of Columbia, or a possession of the United States,
 9. A futures commission merchant registered with the Commodity Futures Trading Commission,
 10. A real estate investment trust,
 11. An entity registered at all times during the tax year under the Investment Company Act of 1940,
 12. A common trust fund operated by a bank under section 584(a),
 13. A financial institution,
 14. A middleman known in the investment community as a nominee or custodian, or
 15. A trust exempt from tax under section 664 or described in section 4947.

The following chart shows types of payments that may be exempt from backup withholding. The chart applies to the exempt payees listed above, 1 through 15.

IF the payment is for . . .	THEN the payment is exempt for . . .
Interest and dividend payments	All exempt payees except for 9
Broker transactions	Exempt payees 1 through 5 and 7 through 13. Also, C corporations.
Barter exchange transactions and patronage dividends	Exempt payees 1 through 5
Payments over \$600 required to be reported and direct sales over \$5,000 ¹	Generally, exempt payees 1 through 7 ²

¹ See Form 1099-MISC, Miscellaneous Income, and its instructions.

² However, the following payments made to a corporation and reportable on Form 1099-MISC are not exempt from backup withholding: medical and health care payments, attorneys' fees, gross proceeds paid to an attorney, and payments for services paid by a federal executive agency.

Part I. Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. If you are a resident alien and you do not have and are not eligible to get an SSN, your TIN is your IRS individual taxpayer identification number (ITIN). Enter it in the social security number box. If you do not have an ITIN, see *How to get a TIN* below.

If you are a sole proprietor and you have an EIN, you may enter either your SSN or EIN. However, the IRS prefers that you use your SSN.

If you are a single-member LLC that is disregarded as an entity separate from its owner (see *Limited Liability Company (LLC)* on page 2), enter the owner's SSN (or EIN, if the owner has one). Do not enter the disregarded entity's EIN. If the LLC is classified as a corporation or partnership, enter the entity's EIN.

Note. See the chart on page 4 for further clarification of name and TIN combinations.

How to get a TIN. If you do not have a TIN, apply for one immediately. To apply for an SSN, get Form SS-5, Application for a Social Security Card, from your local Social Security Administration office or get this form online at www.ssa.gov. You may also get this form by calling 1-800-772-1213. Use Form W-7, Application for IRS Individual Taxpayer Identification Number, to apply for an ITIN, or Form SS-4, Application for Employer Identification Number, to apply for an EIN. You can apply for an EIN online by accessing the IRS website at www.irs.gov/businesses and clicking on Employer Identification Number (EIN) under Starting a Business. You can get Forms W-7 and SS-4 from the IRS by visiting IRS.gov or by calling 1-800-TAX-FORM (1-800-829-3676).

If you are asked to complete Form W-9 but do not have a TIN, write "Applied For" in the space for the TIN, sign and date the form, and give it to the requester. For interest and dividend payments, and certain payments made with respect to readily tradable instruments, generally you will have 60 days to get a TIN and give it to the requester before you are subject to backup withholding on payments. The 60-day rule does not apply to other types of payments. You will be subject to backup withholding on all such payments until you provide your TIN to the requester.

Note. Entering "Applied For" means that you have already applied for a TIN or that you intend to apply for one soon.

Caution: A disregarded domestic entity that has a foreign owner must use the appropriate Form W-8.

Part II. Certification

To establish to the withholding agent that you are a U.S. person, or resident alien, sign Form W-9. You may be requested to sign by the withholding agent even if item 1, below, and items 4 and 5 on page 4 indicate otherwise.

For a joint account, only the person whose TIN is shown in Part I should sign (when required). In the case of a disregarded entity, the person identified on the "Name" line must sign. Exempt payees, see *Exempt Payee* on page 3.

Signature requirements. Complete the certification as indicated in items 1 through 3, below, and items 4 and 5 on page 4.

1. Interest, dividend, and barter exchange accounts opened before 1984 and broker accounts considered active during 1983. You must give your correct TIN, but you do not have to sign the certification.

2. Interest, dividend, broker, and barter exchange accounts opened after 1983 and broker accounts considered inactive during 1983. You must sign the certification or backup withholding will apply. If you are subject to backup withholding and you are merely providing your correct TIN to the requester, you must cross out item 2 in the certification before signing the form.

3. Real estate transactions. You must sign the certification. You may cross out item 2 of the certification.

4. Other payments. You must give your correct TIN, but you do not have to sign the certification unless you have been notified that you have previously given an incorrect TIN. "Other payments" include payments made in the course of the requester's trade or business for rents, royalties, goods (other than bills for merchandise), medical and health care services (including payments to corporations), payments to a nonemployee for services, payments to certain fishing boat crew members and fishermen, and gross proceeds paid to attorneys (including payments to corporations).

5. Mortgage interest paid by you, acquisition or abandonment of secured property, cancellation of debt, qualified tuition program payments (under section 529), IRA, Coverdell ESA, Archer MSA or HSA contributions or distributions, and pension distributions. You must give your correct TIN, but you do not have to sign the certification.

What Name and Number To Give the Requester

For this type of account:	Give name and SSN of:
1. Individual	The individual
2. Two or more individuals (joint account)	The actual owner of the account or, if combined funds, the first individual on the account ¹
3. Custodian account of a minor (Uniform Gift to Minors Act)	The minor ²
4. a. The usual revocable savings trust (grantor is also trustee) b. So-called trust account that is not a legal or valid trust under state law	The grantor-trustee ³ The actual owner ³
5. Sole proprietorship or disregarded entity owned by an individual	The owner ³
6. Grantor trust filing under Optional Form 1099 Filing Method 1 (see Regulation section 1.671-4(b)(2)(i)(A))	The grantor ⁴
For this type of account:	Give name and EIN of:
7. Disregarded entity not owned by an individual	The owner
8. A valid trust, estate, or pension trust	Legal entity ⁴
9. Corporation or LLC electing corporate status on Form 8832 or Form 2553	The corporation
10. Association, club, religious, charitable, educational, or other tax-exempt organization	The organization
11. Partnership or multi-member LLC	The partnership
12. A broker or registered nominee	The broker or nominee
13. Account with the Department of Agriculture in the name of a public entity (such as a state or local government, school district, or prison) that receives agricultural program payments	The public entity
14. Grantor trust filing under the Form 1041 Filing Method or the Optional Form 1099 Filing Method 2 (see Regulation section 1.671-4(b)(2)(i)(B))	The trust

¹ List first and circle the name of the person whose number you furnish. If only one person on a joint account has an SSN, that person's number must be furnished.

² Circle the minor's name and furnish the minor's SSN.

³ You must show your individual name and you may also enter your business or "DBA" name on the "Business name/disregarded entity" name line. You may use either your SSN or EIN (if you have one), but the IRS encourages you to use your SSN.

⁴ List first and circle the name of the trust, estate, or pension trust. (Do not furnish the TIN of the personal representative or trustee unless the legal entity itself is not designated in the account title.) Also see *Special rules for partnerships* on page 1.

***Note.** Grantor also must provide a Form W-9 to trustee of trust.

Note. If no name is circled when more than one name is listed, the number will be considered to be that of the first name listed.

Secure Your Tax Records from Identity Theft

Identity theft occurs when someone uses your personal information such as your name, social security number (SSN), or other identifying information, without your permission, to commit fraud or other crimes. An identity thief may use your SSN to get a job or may file a tax return using your SSN to receive a refund.

To reduce your risk:

- Protect your SSN,
- Ensure your employer is protecting your SSN, and
- Be careful when choosing a tax preparer.

If your tax records are affected by identity theft and you receive a notice from the IRS, respond right away to the name and phone number printed on the IRS notice or letter.

If your tax records are not currently affected by identity theft but you think you are at risk due to a lost or stolen purse or wallet, questionable credit card activity or credit report, contact the IRS Identity Theft Hotline at 1-800-908-4490 or submit Form 14039.

For more information, see Publication 4535, Identity Theft Prevention and Victim Assistance.

Victims of identity theft who are experiencing economic harm or a system problem, or are seeking help in resolving tax problems that have not been resolved through normal channels, may be eligible for Taxpayer Advocate Service (TAS) assistance. You can reach TAS by calling the TAS toll-free case intake line at 1-877-777-4778 or TTY/TDD 1-800-829-4059.

Protect yourself from suspicious emails or phishing schemes.

Phishing is the creation and use of email and websites designed to mimic legitimate business emails and websites. The most common act is sending an email to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The IRS does not initiate contacts with taxpayers via emails. Also, the IRS does not request personal detailed information through email or ask taxpayers for the PIN numbers, passwords, or similar secret access information for their credit card, bank, or other financial accounts.

If you receive an unsolicited email claiming to be from the IRS, forward this message to phishing@irs.gov. You may also report misuse of the IRS name, logo, or other IRS property to the Treasury Inspector General for Tax Administration at 1-800-368-4484. You can forward suspicious emails to the Federal Trade Commission at: spam@uce.gov or contact them at www.ftc.gov/idtheft or 1-877-IDTHEFT (1-877-438-4338).

Visit IRS.gov to learn more about identity theft and how to reduce your risk.

Privacy Act Notice

Section 6109 of the Internal Revenue Code requires you to provide your correct TIN to persons (including federal agencies) who are required to file information returns with the IRS to report interest, dividends, or certain other income paid to you; mortgage interest you paid; the acquisition or abandonment of secured property; the cancellation of debt; or contributions you made to an IRA, Archer MSA, or HSA. The person collecting this form uses the information on the form to file information returns with the IRS, reporting the above information. Routine uses of this information include giving it to the Department of Justice for civil and criminal litigation and to cities, states, the District of Columbia, and U.S. possessions for use in administering their laws. The information also may be disclosed to other countries under a treaty, to federal and state agencies to enforce civil and criminal laws, or to federal law enforcement and intelligence agencies to combat terrorism. You must provide your TIN whether or not you are required to file a tax return. Under section 3406, payers must generally withhold a percentage of taxable interest, dividend, and certain other payments to a payee who does not give a TIN to the payer. Certain penalties may also apply for providing false or fraudulent information.

As per Section 14.52 of the Texas Family Code, added by S.B. 84, Acts, 73rd Legislature, R.S. (1993), all bidders must complete and submit with the bid the following affidavit:

MISCELLANEOUS ENFORCEMENT PROVISIONS

SECTION 2.01. Subchapter B, Chapter 14, Family Code, is amended by adding Section 14.52 to read as follows:

Sec. 14.52. INELIGIBILITY TO RECEIVE STATE GRANTS OR LOANS OR BID ON STATE CONTRACTS. (a) A child support obligor who is 30 or more days delinquent in paying child support is not eligible to:

(1) submit a bid or enter into a contract to provide property, materials, or services under a contract with the state; or

(2) receive a state-funded grant or loan.

(b) A sole proprietorship, partnership, corporation, or other entity in which a sole proprietor, partner, majority shareholder, or substantial owner is a delinquent obligor who is ineligible to bid on a state contract under

Subsection (a)(1) of this section may not bid on a state contract as provided by this section.

I, the undersigned vendor, do hereby acknowledge that NO sole proprietor, partner, majority shareholder of a corporation, or an owner of 10% or more of another business entity is 30 days or more delinquent in paying child support under a court order or a written repayment agreement. I understand that under this doe, a sole proprietorship, partnership, corporation or other entity in which a sole proprietor, partner, majority shareholder or a corporation, or an owner of 10% or more of another entity is 30 days or more delinquent in paying child support under a court order or a written repayment agreement is NOT eligible to bid or receive a state contract.

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

(AREA CODE) TELEPHONE () _____

SIGNATURE

TITLE

DATE

PRINTED NAME OF ABOVE

J. CONFLICT OF INTEREST QUESTIONNAIRE

HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT – PURCHASING DEPARTMENT

Notice to Vendors: Conflict of Interest Questionnaire Required by Chapter 176 of the Texas Local Government Code

Effective January 1, 2006, any person or entity who contracts or seeks to contract with HCISD for the sale or purchase of property, goods, or services (as well as agents of such persons) (hereafter referred to as Vendors) are required to file a Conflict of Interest Questionnaire with the District. Each covered person or entity who seeks to or who contracts with HCISD is responsible for complying with any applicable disclosure requirements. HCISD will post the completed questionnaires on its website.

The Conflict of Interest Questionnaire must be filed:

- No later than the seventh business day after the date that the Vendor begins contract discussions or negotiations with the government entity, or submits to the entity an application, response to a request for proposal or bid, correspondence, or other writing related to a potential agreement with the entity.
- The Vendor also shall file an updated questionnaire not later than September 1 of each year in which a covered transaction is pending, **and** the seventh business day after the date of an event that would make a statement in the questionnaire incomplete or inaccurate.

Note: A Vendor is not required to file an updated questionnaire if the person had filed an updated statement on or after June 1, but before September 1 of the year.

Completed forms should be sent to: Harlingen Consolidated Independent School District

Att'n: Purchasing Department

407 N. 77 Sunshine Strip

Harlingen, Texas 78550

The Local Government Officers of the Harlingen Consolidated Independent School District are:

Board of Trustees:

Greg Powers	President
Dr. Nolan Perez	Vice President
Eladio Jaimez	Secretary
Gerry Fleuriet	Member
Dr. Bobby Muniz	Member
Javier De Leon	Member
Dr. Belinda Reininger	Member

Superintendent: Dr. Arturo J. Cavazos

CONFLICT OF INTEREST QUESTIONNAIRE For vendor doing business with local governmental entity		FORM CIQ
<p>This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.</p> <p>This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).</p> <p>By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.</p> <p>A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.</p>	<div style="text-align: center; border-bottom: 1px solid black; margin-bottom: 5px;">OFFICE USE ONLY</div> <div style="padding: 5px;">Date Received</div>	
<p>1 Name of vendor who has a business relationship with local governmental entity.</p>		
<p>2 <input type="checkbox"/> Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)</p>		
<p>3 Name of local government officer about whom the information is being disclosed.</p> <p style="text-align: center; margin-top: 20px;">_____</p> <p style="text-align: center;">Name of Officer</p>	<p>4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.</p> <p style="margin-top: 40px;">A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?</p> <p style="text-align: center; margin-left: 100px;"> <input type="checkbox"/> Yes <input type="checkbox"/> No </p> <p style="margin-top: 20px;">B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?</p> <p style="text-align: center; margin-left: 100px;"> <input type="checkbox"/> Yes <input type="checkbox"/> No </p>	
<p>5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.</p>		
<p>6 <input type="checkbox"/> Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).</p>	<p>7</p> <p style="margin-top: 20px;"> _____ Signature of vendor doing business with the governmental entity </p> <p style="margin-left: 300px; margin-top: 20px;"> _____ Date </p>	

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at <http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm>. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

- (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;
- (B) a transaction conducted at a price and subject to terms available to the public; or
- (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed;

or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

K. FELONY CONVICTION NOTIFICATION, DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION SIGNATURE PAGE (THIS NOTICE IS NOT REQUIRED OF A HELD CORPORATION)

I. FELONY CONVICTION NOTIFICATION

State of Texas Legislative Senate Bill No. 1, Section 44.034, Notification of Criminal History, subsection (a), states “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 or 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 for services performed before the termination of the contract. This section does not apply to a publicly held corporation.

Signature below acknowledges compliance with Section I. FELONY CONVICTION NOTIFICATION.

COMPANY _____

By: _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE _____

AREA CODE/FAX _____

E-MAIL ADDRESS _____

SIGNATURE TITLE

DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

II.

- a. In accordance with the provisions of Appendix A to 49 CFR (Code of Federal Regulations), Part 29, the Proposer certifies to the best of the Proposer's knowledge and belief, that it and its principals:
 - (1) are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State or Local Government department or agency;
 - (2) have not within a three (3) year period preceding this offer been convicted of or had a civil judgment rendered against them for the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes, or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - (3) are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local with commission of any of the offenses enumerated in (a)(2) above; and
 - (4) have not within a three (3) year period preceding this offer had one or more public transactions (Federal, State, or local) terminated for cause or default.
- b. Where the Proposer is unable to certify to any of the statements above, the Proposer shall attach a full explanation to this offer.
- c. For any subcontract at any tier expected to equal or exceed \$25,000.
- (5) In accordance with the provisions of Appendix B to 49 CFR, Part 29, the prospective lower tier subcontractor certifies, by submission of this offer, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
- (6) Where the prospective lower tier participant is unable to certify to the statement, above, an explanation shall be attached to the offer.
- (7) This certification (specified in paragraphs (c) (1) and (c) (2), above), shall be included in all applicable subcontracts and a copy kept on file by the prime contractor. The prime contractor shall be required to furnish copies of the certifications to the Authority upon request.

Signature below acknowledges compliance with Section II. DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION.

COMPANY _____

By:

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE _____

AREA CODE/FAX _____

E-MAIL ADDRESS _____

SIGNATURE

TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

Harlingen Consolidated Independent School District

407 N. 77 Sunshine Strip

Harlingen, TX 78550

L. PROHIBITION ON CONTRACTS WITH COMPANIES BOYCOTTING ISRAEL

H.B. No. 89, Sec. 2270.002 states:

A governmental entity may not enter into a contract with a company for goods or services unless the contract contains a written verification from the company that it:

(1) does not boycott Israel; and

(2) will not boycott Israel during the term of the contract.

For complete copy of H.B. No 89, Sec. 2270.002 please click here:

ftp://ftp.legis.state.tx.us/bills/85R/billtext/html/house_bills/HB00001_HB00099/HB00089S.htm

I acknowledge compliance with Texas H.B. No 89, Sec. 2270.002 that my company does not boycott Israel and will not boycott Israel during the term of this contract.

COMPANY _____

BY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE _____

AREA CODE/FAX _____

E-MAIL ADDRESS _____

SIGNATURE

TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

M. PROHIBITION OF COMPANIES HAVING CONTRACTS WITH A FOREIGN TERRORIST ORGANIZATION

N. COMPETITIVE SEALED PROPOSAL FORM AND SIGNATURE PAGE

SEE SECTION III – PROJECT SPECIFICATION SECTION 000400 FOR COMPETITIVE SEALED PROPOSAL FORM

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS.

**Harlingen Consolidated Independent School District
407 N. 77 Sunshine Strip
Harlingen, TX 78550**

II. GENERAL SPECIFICATIONS AND INTENT

A. General

It is the intent of this Request for Competitive Sealed Proposals (CSP) to acquire proposals from duly licensed and highly qualified companies to furnish and install complete Renovations and Additions to Treasure Hills Elementary School. The renovations and additions to Treasure Hills Elementary will include all materials, equipment, and labor as further detailed herein and shall be installed by duly licensed personnel as required by Statutory Licensure Requirements and Contractor shall be a Factory authorized Servicing Agent for the Product to be installed.

The Undersigned agrees to commence work within ten (10) days of Notice to Proceed, WHICH WILL BE NO LATER THAN MONDAY, JULY 2, 2018, and to be substantially complete with the work within 365 CALENDAR DAYS. Campus Principals will allow work during school time hours; and, HCISD will arrange for contractor to work during late afternoon and late night through 11:00pm. Weekend work may also be allowed should contractor request. **ABSOLUTELY NO WORK WILL BE ALLOWED ON CAMPUS DURING STANDARDIZED TESTING.** A calendar has been included herein for your consideration.

B. Instructions to Vendors

1. Not Used.
2. HCISD terms and conditions are stipulated in these specifications. Proposal should detail all requirements pertinent to their submittal, identify unacceptable or differentiating terms/conditions, and shall include all pertinent cost data.

C. Evaluation Process

HCISD shall require contractors to provide responses to this CSP that will meet or exceed HCISD's requirements as described in specifications named herein. Contractor's proposals shall be evaluated for completeness with all required documents requested to be included with their submittals. HCISD reserves the right to reject any or all proposals to better meet the needs of the District.

D. Questions

Any questions concerning information contained herein or additionally required shall be addressed in writing to ROFA ARCHITECTS, INC., 1007 Walnut Avenue, McAllen, TX 78501. (Attn: MICHAEL ALLEX, AIA – email address - mikea@rofainc.com). After all questions have been completed, a composite list of questions and answers will be sent to all proposers via Addendum.

E. Response Guidelines

Respondents are encouraged to focus on the specifics of the solution offered. Vendors may include additional literature outlining features or benefits of their offering. Any documentation forwarded to HCISD as a result of this CSP will be held incorporated into the contract if awarded. Vendor will supply documentation required in subsequent sections as an attachment to responses.

F. Technical Support

Not Used.

G. References

In compliance with the ranking criteria, **List three (3) customer references** as requested therein.

H. Vendor Performance

Not Used.

I. Insurance

Vendor shall procure and maintain during the term of the Agreement and any extensions or renewals thereof, general liability, property damage/bodily injury insurance naming Customer as an additional insured in a minimum amount of \$1,000,000 per occurrence. Additionally, vendor will furnish certificate of coverage for Workers Compensation Insurance, and maintain said coverage for the duration of the contract. This insurance shall be acquired from a reputable and financially responsible insurance company. Vendor shall furnish to Customers certificates specifying the names of insurers, policy numbers, and expiration dates establishing that such insurance has been procured and is being maintained.

- .1 Comprehensive or Commercial General Liability (including Premises Operations; Independent Contractors' Protective; Products and Completed Operations; Broad Form Coverage):
 - (a) Bodily Injury and Property Damage Combined:
\$500,000 Each Occurrence
\$500,000 Aggregate
 - (b) Products and Completed Operations shall be maintained for at least five years after Substantial Completion and certificates shall be filed annually with the Owner during this period of time:
\$500,000 Aggregate
 - (c) Property Damage Liability Insurance shall provide X, C, and U coverage.
 - (d) Broad Form Property Damage Coverage shall include Completed Operations.
- .2 Contractual Liability:
 - (a) Bodily Injury and Property Damage Combined:
\$500,000 Each Occurrence
\$500,000 Aggregate
- .3 Personal Injury, with Employment Exclusion deleted:
\$500,000 Aggregate
- .4 Business Auto Liability (including owned, non-owned and hired vehicles):
 - (a) Bodily Injury:
\$250,000 Each Person
\$500,000 Each Occurrence
 - (b) Property Damage:
\$100,000 Each Occurrence
 - (c) or a Combined Single Limit (CSL) of at least \$800,000.
- .5 Umbrella Liability Insurance:
 - (a) Limits: \$1,000,000 such limit shall extend, without limitation, to care, custody, and control of real estate and personal property.

- (b) The Owner, the Engineer, and all Consultants listed on the Title Page of the Project Manual shall be an additional insured on the Contractor's policy as to the subject job.
- (c) This policy shall provide coverage over the Employer's Liability, comprehensive general liability, and comprehensive automobile liability.

J. Bonds

Successful contractor will be required to provide a **Payment and Performance Bond for 100%** of the awarded contract amount.

K. Workers' Compensation Insurance

Pursuant to Texas Labor Code Chapters 401, and 406 and 28 Texas Administrative Code Section 110.110, all employees of contractors or subcontractors must be covered by workers' compensation insurance. In this section, the Proposer who is awarded a contract is referred to as the "Contractor".

A copy of a certificate of insurance, a certificate of authority to self-insure issued by the Texas Workers' Compensation Commission, or a coverage agreement (DWC-81, DWC-82, DWC-83, or DWC-84), showing statutory Workers' Compensation insurance coverage for the person's or entity's employees providing services on a Project is required for the duration of the Project.

Duration of the Project includes the time from the beginning of the Work on the Project until the Contractor's/person's Work on the Project has been completed and accepted by the governmental entity.

Persons providing services on the Project ("Subcontractor" in Texas Labor Code 406.096) include all persons or entities performing all or part of the services the Contractor has undertaken to perform on the Project, regardless of whether that person contracted directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, contractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the Project.

Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a Project. Services do not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code Section 401.011(44) for all employees of the Contractor providing services on the Project for the duration of the Project.

The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

The Contractor shall obtain from each person providing services on a Project, and provide to the governmental entity:

- a. A certificate of coverage, prior to that person beginning Work on the Project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the Project; and
- b. No later than seven (7) days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.

The Contractor shall retain all required certificates of coverage for the duration of the Project and for one (1) Year thereafter.

The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.

The Contractor shall post on each Project site a notice, in the text, form, and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

The Contractor shall contractually require each person with whom it contracts to provide services on a Project, to:

- a. Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011(44) for all of its employees providing services on the Project for the duration of the Project;
- b. Provide to the Contractor, prior to that person beginning Work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project for the duration of the Project;
- c. Provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
- d. Obtain from each other person with whom it contracts, and provide to the Contractor:
 - (1) A certificate of coverage, prior to the other person beginning Work on the Project; and
 - (2) A new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
- e. Retain all required certificates of coverage on file for the duration of the Project and for one (1) year thereafter;
- f. Notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the person knew, or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and
- g. Contractually require each person with whom it contracts to perform as required by items a-f, with the certificates of coverage to be provided to the person for whom they are providing services.

By signing a contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the governmental entity 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 the coverage will be based on proper reporting of 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.

The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor that entitles the governmental entity to declare the contract void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the governmental entity.

The coverage requirement recited above does not apply to sole proprietors, partners, and corporate officers who are excluded from coverage in an insurance policy or certificate of authority to self-insure that is delivered, issued for delivery, or renewed on or after January 1, 1996. 28 TAC 110.110(i).

L. Prevailing Wages

Pursuant to Texas Government Code, Chapter 2258, it shall be mandatory upon the Contractor and upon any Subcontractor under him to pay not less than the prevailing rates of per diem wages in the locality at the time of construction to all laborers, workmen, and mechanics employed by them in the execution of the contract.

In accordance therewith, the Owner has established a scale of prevailing wages which is incorporated in the Project specifications, and not less than this established scale must be paid on the Project. Any workers not included in the schedule shall be properly classified and paid not less than the rate of wages prevailing in the locality of the Work at the time of construction.

A Contractor or Subcontractor who violates the provisions of Sections 3.4.1.1 or 3.4.1.2 shall pay to Owner the sum of Sixty Dollars and No/100 (\$60.00) for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rate stipulated in the scale of prevailing wages applicable to this Project, as required by Texas Government Code Section 2258.023(b).

PREVAILING WAGE SCHEDULE

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====

END OF GENERAL DECISION

SECTION 00310

PROPOSAL FORM FOR COMPETITIVE SEALED BIDS

BID FROM: _____

ATTN: MR. TONY GRACIA, DIRECTOR OF PURCHASING

RE: TREASURE HILLS ELEMENTARY SCHOOL - 2018-2019 ADDITIONS AND RENOVATIONS for HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT, Harlingen, TX 78550

The Undersigned proposes to furnish all labor, services, materials, tools, and necessary equipment for the construction of the **TREASURE HILLS ELEMENTARY SCHOOL - 2018-2019 ADDITIONS AND RENOVATIONS for HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT, Harlingen, TX 78550** and to perform the work required for the construction of said project at the location set out by the Drawings, Project Manual and Specifications, in strict accordance with the Contract Documents for the completed work.

In submitting this Proposal, it is understood that this Proposal may not be altered or withdrawn for sixty (60) calendar days and that the Owner has reserved the right to reject any and all Proposals.

The Undersigned certifies that this Proposal is made in good faith, without collusion or connection with any other person, persons, partnership, company, firm, association, or corporation offering on this work, for the following sum or prices to wit:

BASE BID: _____

_____ (\$ _____) DOLLARS

The Undersigned further agrees that in case of authorized variations of quantities from those shown or specified, the attached **UNIT PRICE SCHEDULE** will be used in adjusting the Contract Price.

The Undersigned hereby declares that he/she has visited the site and has carefully examined the Drawings, Specifications, Contract Documents and Proposal Documents related to the Work covered by this proposal.

Upon receipt of "**NOTICE TO PROCEED**", the Undersigned will immediately execute the formal contract (Agreement).

The Undersigned agrees to commence work within ten (10) days of Notice to Proceed, WHICH WILL BE NO LATER THAT MONDAY, JULY 2, 2018, and to be substantially complete with the work within 365 CALENDAR DAYS.

The Contract required will be that Standard Form of the American Institute of Architects or an owner modified form and shall provide for payment on accounts of ***ninety-five (95%)*** percent of the value monthly.

The Proposal, the Agreement, the Drawings, the General Conditions, Supplementary General Conditions, the Specifications and any Addenda shall all become a part of the Contract.

I HEREBY ACKNOWLEDGE RECEIPT OF THE FOLLOWING ADDENDUM:

BONDING COMPANY(IES):

(Name and address)

If awarded this contract, the offerer intends to use the following subcontractors:

ELECTRICAL: _____

PLUMBING: _____

AIR CONDITIONING: _____

STRUCTURAL STEEL FABRICATOR: _____

AISC Certificate Number: _____

Or

IAS - ICC Certificate Number: _____

Or

IBC - Certificate Number: _____

Respectfully Submitted:

BY: _____

FIRM: _____ If corporation affix seal here

TITLE: _____

DATE: _____

SECTION 00310

BID PROPOSAL FORM (UNIT PRICES)

- A. In case of additions or deletions to the Work from the Work shown in the Contract Documents, the following Unit Prices shall be used in adjusting the Contract Price. All Unit Prices shall remain in effect until completion of the Project. All Unit Prices shall be the total cost for material, labor, tax if applicable insurance mark-ups, overhead and profit.

ITEM	ADD	DEDUCT
1. <i>Resilient Flooring as specified in Section 09660. (VCT)</i>	\$ /S.F.	\$ /S.F.
2. <i>Tape, float and paint gypsum board as specified in Section 09900 (one side).</i>	\$ /S.F.	\$ /S.F.
3. <i>4 1/2" X 4 1/2" Ceramic Wall Tile as specified in Section 09312'</i>	\$ /S.F.	\$ /S.F.
4. <i>Markerboards/Tackboards: (Section 10100, Paragraph 2.02A):</i>		
a) 20'-0" x 4'-0"	\$ /each	\$ /each
b) 10' x 0" x 4'-0"	\$ /each	\$ /each
c) 12'-0" X 4'-0"	\$ /each	\$ /each
d) 8' x 0" x 4'-0"	\$ /each	\$ /each
e) 6'-0" x 4'-0"	\$ /each	\$ /each
f) 4'x0" x 4'-0" Tackboards	\$ /each	\$ /each
g) 8'-0" x 4'-0" Tackboards	\$ /each	\$ /each
h) 20'-0" x 4'-0" Tackboards	\$ /each	\$ /each
i) 20'x 2' -0" Tackboards	\$ /each	\$ /each
5. <i>120 duplex wall outlet – device, cover plate, and rough-in. Include 10 ft. 1/2" C and 30ft. No. 12 wire (assume new circuit is not required).</i>	\$ /each	\$ /each
6. <i>Multi-purpose wall outlet – empty box, blank cover plate. Include 9 ft. 3/4" conduit, empty.</i>	\$ /each	\$ /each
7. <i>Light Switch, in wall -Empty wall box, cover plate. Include 10 ft of 1/2" C and No. 12 wires.(assume new circuit is not required).</i>	\$ /each	\$ /each
8. <i>24" x 24" ceiling diffuser with 20 ft. of 12" round duct.</i>	\$ /each	\$ /each
9. <i>Water hose bib (exterior) with 50 ft. of 3" copper line including tee and 2 els. 24" deep trench.</i>	\$ /each	\$ /each
10. <i>Fire extinguishes and extinguisher cabinet, as specified.</i>	\$ /each	\$ /each
11. <i>Door, frame, classroom function lock and hardware for: (As applicable)</i>		
a) Type 'A' Door	\$ /each	\$ /each
b) Type 'B' Door	\$ /each	\$ /each
c) Type 'D' Door	\$ /each	\$ /each
d) Type 'E' Door	\$ /each	\$ /each
e) Type 'F' Door	\$ /each	\$ /each
12. <i>Acoustical tile Type "C.1" and suspension system – SECTION 09511</i>	\$ /S.F.	\$ /S.F.
13. <i>Gyp. Bd. Ceiling</i>	\$ /S.F.	\$ /S.F.

SECTION 00310UP
PROPOSAL FORM (UNIT PRICES)

14. Masonry partitions, provide for material and labor: a) 8"x 8" x 16" CMU installed with mortar, reinforcement & grouting. b) 12"x 8" x 16" CMU installed with mortar, reinforcement & grouting. c) Modular size brick installed with mortar & reinforcement.	\$ /S.F. \$ /S.F. \$ /S.F.	\$ /S.F. \$ /S.F. \$ /S.F.
15. 4" thick sidewalk.	\$ /S.F.	\$ /S.F.
16. Metal stud wall framing, provide for material and labor: a) 3 5/8" x 12' tall metal partition to include sill and top runners. b) 6" x 12' tall metal partition to include sill and top runners.	\$ /Ln. Ft. \$ /Ln. Ft.	\$ /Ln. Ft. \$ /Ln. Ft.

Respectfully Submitted:

 By:

 Date:

Business Address Complete:

Seal, If Bid is by a Corporation.

SECTION 00410

SECURITY BOND

PART 1: GENERAL:

1.01 SECURITY BOND FORM:

- A. The "Security Bond", **AIA Document A310, (as provided in Section 00400)** will be the form used as a Bid Bond for this Project. Amount of the Security Bond shall be set forth in the Proposal Instructions.
- B. A copy of the Standard AIA Document may be examined at the office of the Architect. To purchase original blank form call the LRGV/AIA local office at 956-994-0939 Copies may be purchased from the American institute of Architects, 1735 New York Avenue, N.W., Washington, D.C., 20006.
- C. Each proposal shall be accompanied by a Security Bond pledging that the Offeror will enter into contract with the Owner on the terms stated in his Proposal and will furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder.
- D. Should the offeror refuse to enter into such a Contract or fail to furnish such bonds, the amount of the security bond shall be forfeited to the Owner as liquidated damages, not as a penalty.
- E. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified or current copy of his power of attorney.
- F. The Owner will have the right to retain the security bond of Offerors to whom an award is being considered until the Contract has been executed and the bonds have been furnished, or the specified time has elapsed so that Proposals may be withdrawn, or all Proposals have been rejected.

END OF SECTION

SECTION 00500
STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR
(STIPULATED SUM)

PART 1: GENERAL:

The Owner will use the following the AIA Document as a form of contract with The General Contractor: A101-2007

1.01 AGREEMENT FORM:

- A. The "Standard Form of Agreement Between Owner and Contractor where the Basis of Payment is a Stipulated Sum", AIA Document A101, **(as provided herein)** will be the form used as a Contract for this Project.
- B. A copy of the Standard AIA Document may be examined at the office of the Architect. To purchase original blank form call the LRGV/AIA local office at 956-994-0939 copies may be purchased from the American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C., 20006.
- D. Modification may be made to the above agreement or an Owner provided agreement may be utilized. Either of which will be provided to contractor for review upon award of project, for final execution of the contract.

END OF SECTION

SECTION 00615

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

PART 1: GENERAL:

1.01 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND:

- A. The Contractor shall, prior to the execution of the Contract, furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in the amount of 100% of the Contract Price covering 100% performance and 100% payment, and with such sureties secured through the contractor's usual sources as may be agreeable to the parties. **Contractor shall use forms AIA A312-184 and AIA A312-2-2010, as provides in Section 00400.**
- B. The Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract, or if the work is commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.
- C. 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 his Power of Attorney.
- D. Any Payment Bond and Performance Bond furnished pursuant to the provisions of Art. 5160, Vernon's Texas Civil Statutes, connected with this project, shall be furnished by a corporate surety or corporate or corporate sureties in accordance with Article 7.19-1, Vernon's Texas Insurance Code, that has a stated capital and surplus (as reported by it to the Texas Insurance Commission in its most recent report) that is in excess of ten times the stated amount of the Payment bond or the Performance Bond. Provided however, that if any Payment Bond or any Performance Bond is in an amount in excess of ten percent (10%) of the surety company's capital and surplus (as reported to the Texas Insurance Commission in its most recent report), as a condition to accepting the bond, the Owner must receive written certification and information, satisfactory in form and substance to the Owner, that the surety company has reinsured the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus, with one or more reinsurers who are duly authorized, accredited or trusted to do business in the State of Texas. For the purpose of this requirement, any amount reinsured by any reinsurer may not exceed ten percent (10%) of the reinsurer's capital and surplus (as reported to the Texas Insurance Commission by the reinsurer in its most recent report). In the event there is one or more reinsurer, the surety company must provide all necessary information and certification related to the current financial condition of the surety company and any and all reinsurers required by the Owner, together with copies of all reinsurance contracts with the surety company, before any such Payment Bond and Performance Bond is eligible to be considered acceptable by the Owner.
- E. ALL CONTRACTORS SHALL SUBMIT THE NAME, ADDRESS AND TELEPHONE NUMBER OF THE CORPORATE SURETIES PROVIDING THE PAYMENT BOND AND PERFORMANCE BOND AND THE LOCAL AGENT.

END OF SECTION

SECTION 00710

GENERAL CONDITIONS OF THE CONTRACT

PART 1: GENERAL:

1.01 GENERAL CONDITIONS:

- A. The General Conditions of this Contract is the American Institute of Architects Document A201, "General Conditions of the Contract for Construction", **2007, Fourteenth Edition**, hereinafter referred to as the "General Conditions".
- B. A copy of the Document is available at the Architect's office, and shall apply to each and every Section of the Work as though written in full therein. To purchase original form call the LRGV/AIA office at 956-994-0939.
- C. Modifications may be made to the above General Conditions or Owner provided General Conditions may be utilized. Either of which will be provided contractor for review upon award of project, for final execution of the contract.
- D. **For modification to A201, See Section 00800 Comprehensive Standard Form of Agreement Between Harlingen CISD and Contractor and Section 00811 Supplementary Conditions.**

END OF SECTION

SECTION 00800
COMPREHENSIVE STANDARD FORM of AGREEMENT BETWEEN
HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT AND
CONTRACTOR

PART 1: GENERAL

The General Conditions of the Contract for Construction, AIA Documents 201-2007 will be modified as per the form that follows:

COMPREHENSIVE STANDARD FORM OF AGREEMENT

BETWEEN

OWNER AND CONTRACTOR

This Agreement is entered into between the ***Owner***, Harlingen Consolidated Independent School District, 1901 North 77 Sunshine Strip, Harlingen, Texas 78550, and the ***Contractor***, _____, for the following Project dated _____. This Project is described as: ***&*** _____.

The Owner and Contractor agree as follows:

A. The Contract documents consist of the following:

1. This Comprehensive Standard Form of Agreement Between Harlingen Consolidated Independent School District (Owner) and _____(Contractor) (***hereinafter referred to as the Standard Form***).

2. The Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum, AIA document A101-2007 which is attached hereto (***hereinafter referred to as the "Agreement"***) and as modified in this Standard Form.

3. The general conditions of the Contract for Construction, AIA document A201-2007, which is attached hereto and as herein modified and amended (***hereinafter***

referred to as the “General Conditions”).

4. Supplementary and Other Conditions which may be agreed to in writing.

5. The drawings and specifications.

6. Addenda issued prior to execution of this Agreement.

7. Other documents listed in this Standard Form or in the Agreement and modifications issued after execution of the Standard Form.

These 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 modifications, appears in Article 8 of the **Agreement**.

B. Modifications and Supplementary Agreements to the **Agreement**.

1. Article 1 of the **Agreement** is deleted.

C. The following supplements, modify, change and delete from or add to the **General Conditions** of the Contract for Construction AIA document A201 -

2007. Where an article of the General Conditions is modified or any paragraph, subparagraph, or clause thereof is modified or deleted by these supplements, the unaltered provisions of that article, paragraph, subparagraph, or clause shall remain in effect.

Article 1: General Provisions.

1.1.1 Delete this subparagraph.

Add; 1.2.1.2 In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the Architect’s interpretation.

Article 2:

Modify; 2.1.2 At the end of the first sentence, delete the words “mechanic’s lien rights” and substitute “bond claims”

Delete; 2.2.1 Delete this paragraph.

Article 3: Contractor:

Add; 3.3.4 Add the following paragraph:

The Contractor expressly recognizes that the Architect does not owe him any duty to supervise or direct his work as to protect the Contractor from the consequences of his own acts or omissions.

Add; 3.4.1.1 The Contractor shall certify in writing that no materials used in the work contain lead or asbestos materials in them in excess of amounts allowed by Local/State standards, laws, codes rules and regulations; the Federal Environmental Protection Agency (EPA) standards and/or the Federal Occupational Safety and Health Administration (OSHA) standards, whichever is most restrictive. The Contractor shall provide this written certification as part of submittals under Section 01700, Contract Closeout.

Add; 3.4.3.1 Smoking, including e-cigarettes (vapor type) and chewing of tobacco products is prohibited in enclosed new construction.

Add; 3.4.3.2 No glass bottles shall be brought on the construction site or Owner's property by any construction personnel.

Modify; 3.9.1 Delete the paragraph and substitute the following:

Prior to commencement of the work, Contractor shall provide Owner and Architect with a resume of the Superintendent. Within seven (7) days of Owner and Architect's receipt of the Superintendent's resume, Owner or Architect may object in writing to the selection of the Superintendent. Contractor shall substitute a Superintendent replacement acceptable to Owner and Architect upon receipt of the Objection. At any time during construction, Owner or Architect may

request in writing replacement of the Superintendent. The Contractor shall replace the Superintendent within ten (10) days of receipt of such written request.

Article 4: Architect

Modify; 4.1.3 Delete the paragraph and substitute the following: If the employment of the Architect is terminated, the Owner shall employ a new Architect whose status under the Contract documents shall be that of the formal Architect.

Add; 4.2.10.1 The Architect may appoint an employee or other person to assist him during the construction. These representatives will be instructed to assist the Contractor in interpreting the Contract Documents; however, such assistance shall not relieve the Contractor from any responsibility as set forth by the Contract Documents. The fact that the Architect's Representative may have allowed work not in accordance with the Contract Documents shall not prevent the Architect from insisting that the faulty work be corrected to conform with the Contract Documents and the Contractor shall correct same.

Article 7: Changes in the Work.

Add; 7.2.2 The total Contractor mark-up for overhead and profit on any Change Order shall not exceed 10%. On work performed by a subcontractor and supervised by the Contractor, the total Contractor mark-

up for overhead and profit for any change order shall not exceed 5%.

Article 8: Time

Modify; 8.3.1 Delete the phrase “or by delay authorized by the Owner pending mediation and arbitration”. Add the following sentence to the end of the subparagraph; “Extensions of time shall be granted only because of delay preventing the execution of the major items of work critical to the schedule for completion of the Work.”

Add; 8.3.4 Extensions of time will be granted only for loss of scheduled work days, not for loss of calendar days.

Add; 8.3.5 The Contractor shall include in his base bid proposal all overhead and profit necessary to complete the project. No additional overhead or profit will be paid for extensions of time granted for loss of scheduled work days.

Add; 8.3.6 In the event that the Owner has specified a stipulated completion date, the provisions of 8.3.1 through 8.3.3 do not apply. However, in the event of delay(s) fully beyond the Contractor’s control, the Owner may authorize by change order reimbursement for additional costs to accelerate the construction in order to maintain the stipulated completion date.

Article 9: Payments and Completion

Modify; 9.3.1 Add the following sentence: The form of application for payment shall be AIA Document G702, (Notarized) Application for Certification of Payment, Supported by AIA Document G703, Continuation Sheet.

Modify; 9.6.1 Substitute the following paragraph: After the Architect has issued a certificate of payment, the Owner shall make payments on account of the contract as follows:

Interim Payment: No later than fifteen (15) days following the end of the period covered by the application for payment, not less than ninety-five percent (95%) of the value based on the contract prices for labor and material incorporated in the work and of materials suitably stored at the site thereof unto the date of application for payment, as estimated by the Architect, less the aggregates of previous payments.

Modify; 9.6.7 Delete paragraph and substitute with the following: “Unless the Contract provides the Owner with the 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.

Modify; 9.7 In the first sentence delete the words “or awarded by binding dispute resolution”.

Modify; 9.10.1 Add the following sentence at end of paragraph: “Final payment shall be due thirty (30) days after final completion provided the conditions set forth in Par. 9.10.2 have been fulfilled.

Modify; 9.10.2 All references in this paragraph to mechanic’s liens or liens should be deleted and replaced with “bond claim”. Add the following to the end of the section: At the option of the Owner if Contractor fails to complete any punch list items within thirty (30) days after written demand is made on Contractor to complete said items, Owner may :(i) Contract with another contractor to complete the items and deduct the cost of the completion work from Final Payment or (ii) Withhold final payment and no final payment shall be due. Punch list items shall be defined as those items identified by the Architect as necessary to complete the Project after a Certificate of Substantial Completion has been submitted to the Owner by the Architect.

Delete; 9.10.4 Delete this paragraph.

Add; 9.11 Liquidated Damages

Add; 9.11.1 Liquidated Damages shall be assessed the Contractor at the rate of one thousand and no/dollars (\$1,000.00) per day for each day that actual substantial completion exceeds the agreed completion date.

Add; 9.12 Civil Statutes: “The provision of Art. 601f of Vernon’s Texas Civil Statutes shall not apply to this contract. Times and methods of payment of invoices shall be as specified herein. If no time for payment of invoices is otherwise specified herein, the Owner shall have a reasonable time to make payment. There shall not be interest on any delayed, disputed or delinquent payment, nor shall the Contractor or vendor be entitled to attorney’s fees in any dispute to collect such payment. Contractor or vendor expressly waives and gives up any rights it may have under Art. 601f. To the extent that any other provision in this contract shall conflict with this paragraph, this paragraph shall prevail.”

Article 10: Protection of Persons and Property

Add; 10.2.2.1 The Contractor shall comply with and provide for, in all trenching work which will exceed a depth of five feet, trench safety systems that meet current Occupational Safety and Health Administration (OSHA) Standards. The Contractor shall be responsible for incorporating into his base bid the cost of these trench safety systems. All requirements shall be in

accordance with detailed drawings and specifications.

Add; 10.2.2.2 The Contractor shall comply with Federal and State Regulations to verify use of only “lead free” and “asbestos free” materials.

Delete; 10.3.3 Delete this paragraph.

Article 11: Insurance and Bonds

Modify; 11.1.2 Substitute the following:

The insurance required by sub-paragraph 11.1.1 shall be written for not less than any limits of liability indicated below.

1. a. Workmen’s Compensation-Statutory
b. Employer’s Liability
\$300,000.00
2. Comprehensive General Liability
a. Bodily Injury:
Each Occurrence \$300,000.00
Aggregate \$600,000.00
b. Property Damage:
Each Occurrence \$500,000.00
Aggregate \$500,000.00
- or -
c. Combined Coverage
Limit \$1,000,000.00
3. Automobile Liability
a. Bodily Injury:

- Each Person \$500,000.00
Each Occurrence \$500,000.00
- b. Property Damage:
Each Occurrence \$250,000.00
- or -
- c. Combined Coverage
Limit \$750,000.00
4. Independent Contractor’s Liability - Same limit as #2 above.
5. Products and Completed Operations - Same limits as #2 above, commencing with issuance of final certificate of payment and remaining in effect for one (1) year.
6. Property Damage Liability Insurance will provide X, C and U coverage, as applicable.
7. Umbrella Excess Liability - \$1,000,000.00.

Add; 11.1.3 Add the following:

Furnish one copy of certificates herein required for each copy of the agreement; specifically set forth evidence of all coverage required by sub-paragraph 11.1.2.

Modify; 11.1.4 Workers’ Compensation Insurance Coverage.

A. Definitions:

Certificate of coverage (“certificate”)-A copy of a certificate

of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in paragraph 406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to the project. "Services" does not include activities unrelated to the project, such as food/beverage

vendors, office supply deliveries, and delivery of portable toilets.

B. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the contractor providing services on the project, for the duration of the project.

C. The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

D. If the coverage period shown on the contractor's current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The Contractor shall obtain from each person providing services on a project, and provide the governmental entity:

(1) a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(2) no later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

F. The Contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

G. The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contract knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

H. The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

I. The Contractor shall contractually require each person with whom it contracts to provide services on a project, to:

(1) provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section

401.011(44) for all of its employees providing services on the project, for the duration of the project.

(2) provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project.

(3) provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

(4) obtain from each other person with whom it contracts, and provide to the contractor.

(a) a certificate of coverage, prior to the other person beginning work on the project; and

(b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

(5) retain all required certificates of coverage on file for the duration of the project and for one year thereafter.

(6) notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

J. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity 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 the coverage will be based on proper reporting of 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.

K. The contractor's failure to comply with any of these

provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.

L. Contractor indemnifies Owner from any and all loss including court costs, expenses and attorney's fees incurred by Owner in defending or paying any claim arising against Owner which would have not arisen or would have been covered by worker's compensation insurance except for Contractor's failure to insure that persons providing services on the project were insured as required by this section.

Modify; 11.3.1 Delete and substitute the following:

The Contractor shall purchase and maintain property insurance upon the entire Work at the site to the full insurable value thereof. Such insurance shall be in a company or companies against which the Owner has no reasonable objection. This insurance shall include the interests of the Owner, the Contractor, Sub-Contractors and Sub-Subcontractors in the Work and shall insure against the perils of fire and extended coverage and shall include "All Risk" insurance for physical loss or damage including, without duplication of coverage, theft, vandalism and malicious mischief. If not covered under the All Risk Insurance or otherwise provided in the Contract

Documents, the Contractor shall effect and maintain similar property insurance on portions of the Work stored off of the site or in transit when such portion of the Work are to be included in an application for payment under Sub-paragraph 9.3.2. If this insurance is written with stipulated amounts deductible under the terms of the policy, the contractor shall pay the difference attributable to deductions in any payments made by the insurance carrier or claims paid by this insurance.

Delete; 11.3.1.1 Delete this clause.

Delete; 11.3.1.2 Delete this clause.

Delete; 11.3.1.3 Delete this clause.

Delete; 11.3.2 Delete this subparagraph.

Delete; 11.3.3 Delete this subparagraph.

Delete; 11.3.4 Delete this subparagraph.

Delete; 11.3.5 Delete this subparagraph.

Modify; 11.3.6 Delete the first sentence and substitute the following:

Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy

that includes insurance coverage required by this Paragraph 11.3.

Also; Delete the last word of this subparagraph and insert the word “Owner”.

Delete; 11.3.7 Delete this subparagraph.

Modify; 11.3.8 Substitute “Contractor” for “Owner” as fiduciary; except that at the first reference to “Owner” in the first sentence, the word “this” should be substituted for “Owner’s”.

Modify; 11.3.9 Substitute “Contractor” for “Owner” each time the latter word appears.

Modify; 11.3.10 Substitute “Contractor” for “Owner” each time the latter word appears.

Modify; 11.4.1 Delete Par. 11.4.1 and substitute the following:

CONTRACT SECURITY. Performance and Payment Bonds shall be required for all work where the Contract exceeds \$25,000.00. After award of contracts by Owner, the successful Bidder, at Bidder’s expense, must deliver to the Owner an executed Performance and Payment Bond in an amount of 100% of the acceptable bid as security for the faithful performance of the Contract and payment of all persons performing labor and furnishing materials in connection with this Contract. Bonding Company must

be licensed, listed, and approved in the State of Texas (State Board of Insurance). Bonding Company shall provide such other information as necessary to document net worth, stability, total bonding capacity, and projects under coverage, etc., with adequate financial capacity for this Project. If the Contract sum exceeds the underwriting limitation of the Surety on the most recent list of acceptable sureties, the Contractor shall provide the Owner with evidence that the excess is protected by re-insurance or co-insurance in a form and amount acceptable to the Owner. Such bonds shall meet the requirements of Chapter 2253 of the Texas Government Code or as subsequently amended.

Add; 11.5 Antitrust Violations:

“Vendors (Contractor) hereby assigns to purchase (Owner) any and all claims for overcharges associated with the contract (Contract) which arise under the antitrust laws of the United States, 15 U.S.C.A. Sec. 1 et seq. (1973)”.

Article 13: Miscellaneous Provisions

Modify; 13.1 Delete this subparagraph and replace with the following: “This contract shall be governed by the Laws of the State of Texas and shall be perform able within the territory of the Harlingen Consolidated Independent School District in Cameron County, Texas. Notwithstanding that the Contractor’s

residence may be outside of the State of Texas, Contractor agrees and consents to venue of any claim, dispute or litigation in Cameron County, Texas and specifically consents to the jurisdiction of the State, District Courts of the State of Texas in Cameron County.

Add; 13.1.1 The Contract is intended to conform with all of the applicable laws of the State of Texas governing School Districts and Municipalities including the Texas Education Code, the Texas Government Code and all applicable administrative codes and regulations relating to and governing school districts. To the extent that any provision in these contracts contradicts or fails to conform with any such applicable statutes or regulations governing school districts or to Board Policy, this contract shall be deemed to be reformed so as to comply with such statute, regulation or policy imposing upon such party such obligation as may be required by such statute, regulation or policy.

Modify; 13.3 Delete the paragraph and substitute the following: “Written notice to the Contractor shall be deemed to have been duly served if delivered in person to the individual or 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 to the last business address known to the party giving notice. Written notice to the Owner shall be deemed to have been duly served by (1) hand delivery for

which a receipt is given; or (2) by Certified Mail, Return Receipt Requested so along as such hand delivered or certified mail notice is directed to the Superintendent of Schools or the Assistant or Deputy Superintendent of District Operations.

Delete; 13.6 Delete this Paragraph and Subparagraph.

Article 14: Termination or Suspension of the Contract

Delete; 14.1.1.4 Delete this clause.

Modify; 14.2.1 Delete this Subparagraph and replace with the following: "The Owner may terminate the Contract if the Contractor:

- (1) refuses or fails to supply enough properly skilled workers or proper materials;
- (2) fails to make payments to subcontractors for materials or labor in accordance with the respective agreements between the Contractor and Subcontractor;
- (3) disregards laws, ordinances, or rules, regulations or orders of the public authority having jurisdiction; or

- (4) fails to comply with any provision of the Contract documents.

Modify; 14.2.2 Delete from this paragraph the following words contained in the first sentence: "upon certification by the Architect that sufficient cause exists to justify such action".

Article 15: Claims and Disputes

Modify; 15.1.2 Delete the paragraph and substitute the following: Time Limits on Claims by Contractor. Claims by the Contractor must be initiated within twenty-one (21) days after the occurrence of the event giving rise to such claim more than twenty-one (21) days after the Contractor first recognizes the condition giving rise to the claim, whichever is later. Claims must be initiated by written notice to the Architect and the Owner. There is no obligation on the Owner to make a claim within twenty-one (21) days after the first observance of an objectionable conditions. There is no obligation on the Owner to make a claim within twenty-one (21) days after the first observance of the conditions. Each reference to the duty on the part of the party to give notice within twenty-one (21) days shall be deemed only to apply to the Contractor.

Add; 15.1.5.3 There is no obligation on the Owner to make a claim within twenty-one (21) days after the first observance of the

objectionable conditions. Each reference to the duty on the part of the party to give notice within twenty-one (21) days shall be deemed only to apply to the Contractor.

Add; 15.1.5.4 A guide for average climatological conditions shall be the bulletin "Local Climatological Data", published by the Department of Commerce. No request for an extension of time due to weather conditions shall be considered unless accompanied by Weather Bureau documentary evidence showing by comparison that such weather is abnormal to any of the past five (5) years.

Modify; 15.1.6 Delete in its entirety and in its place insert: "The Contractor waives Claims against the Owner for consequential damages arising out of or relating to this Contract. This waiver includes 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 waiver is applicable, without limitation, to all consequential damages due to Owner's termination in accordance with Article 14. Nothing contained in this subparagraph 15.1.6 shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

Add; 15.1.7 If a Claim relates to or is the subject of a bond claim, the party asserting such Claim may proceed in accordance with the applicable law to comply with the bond notice or filing deadlines prior to resolution of the Claim by the Architect.

OWNER:

**HARLINGEN CONSOLIDATED
INDEPENDENT SCHOOL
DISTRICT**

By _____

Its _____

CONTRACTOR:

By: _____

Its: _____

SECTION 00801
OWNER'S SPECIAL PROVISIONS

Specifications which Apply

All work under this contract shall conform to the requirements of these specifications.

In cases where the standard specifications are in conflict with either Plans and Specifications or the Special Provisions, the order of supersedence shall be Special Provisions, Specifications and Plans.

All labor, materials, equipment, supervision and other services required for this construction will be furnished in accordance with plans and specifications as prepared by the Owner.

All work to be performed in close association with project Owner / designer. Before civil, site improvements proceed, verify locations with the District Operation's staff.

Harlingen CISD along with their Consultant personnel have delineated work areas and access routes. Any damaged property not otherwise mentioned within plans or specifications to be installed, shall be the responsibility of the contractor (product and installation) as approved by District personnel.

Contractor will not be allowed use of existing bathrooms and will provide for his personnel's needs through the lease / rental of portable bathroom units at his own expense. The location / placement of these units will be mutually agreed to by Owner and Contractor prior to placement.

Security Measures

A contractor's superintendent shall be on the job at all times that construction workers are present at the construction site. All construction personnel shall wear safety vests, hard hats and appropriate footwear protection at a minimum. Other personal injury protection gear may be required to perform duties on site and will be the responsibility of the General Contractor as well as the sub-contractors. Additionally, use or storage of explosives or other volatile materials on this site is expressly forbidden.

Testing

The Owner reserves the option of testing any and all materials used in this construction. All testing will be made by an independent laboratory designated and paid by the

Owner, unless otherwise stated in the specifications of the items to be tested. Any costs associated with retesting of materials shall be the responsibility of the contractor as required by the District. Any construction materials not meeting specifications may be rejected at contractor's expense or may be accepted by the District provided an appropriate deduction is granted and agreed upon by the Owner. District personnel must be notified 24 hours in advance of materials testing.

Schedule and Sequence of Construction

The Contractor shall, prior to beginning work, prepare and submit a proposed schedule of work to the Owner for his approval, as required. Work schedule to be planned in coordination with District personnel and performed such that minimal interference to District staff and students occurs. Recommended construction hours are between 7:00 am and 5:00 pm.

Utilities

Contractor to provide for his own utility requirements.

Building Permit and Taxes

A building permit may be required for the construction of this project and will be the responsibility of the General Contractor.

Material Deliveries

District Operation staff shall explain how material deliveries are to arrive and where materials and workman tool boxes may be stored at the pre-construction meeting.

Inspection of Work

The Owner will provide sufficient competent personnel, together with its Consultants, working under the supervision of a qualified Architect/Engineer, for the inspection of the work while such work is in progress to ascertain that the completed work will comply in all respects with the standards and requirements set forth in the specifications. Contractor will be responsible for payment of City inspection personnel if major work related issues are schedule outside of the normal business hours, as is required by the

City of Harlingen. Notwithstanding such inspection, the Contractor will be held responsible for the acceptability of the finished work.

The Architect / Engineer and Owner and their representatives shall at all times have access to the work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

If the specifications, the Architect's/Engineer's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Owner / Consultant timely notice of its readiness for inspection. Inspections by the Consultant shall be made promptly and where practicable at the source of supply. If any work should be covered up without approval or consent of the Architect/ Engineer, it must be uncovered at the Contractor's expense, unless the Consultant has unreasonably delayed inspection.

Re-examination of the work may be ordered by the Owner and if so ordered, the work must be uncovered by the Contractor. If such work is found to be in accordance with the Contract Documents, the Owner shall pay the cost of re-examination and replacement. If such work is not in accordance with the Contract documents, the contractor shall pay such cost.

Changes in the Work

The Owner may make changes in the Drawings and Specifications or scheduling of the Contract within the general scope at any time by a written order. If such changes add to or deduct from the contractor's cost of the work, the Contract shall be adjusted accordingly. All such work shall be executed under the conditions of the original Contract. In giving instructions, the Owner shall have authority to make minor changes in the work not involving cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Owner, and no claim for an addition to the Contract Sum shall be valid unless the additional work was so ordered.

Competency of Bidders

The Bidder must be capable of performing each of the various items of work bid upon. Upon request, the successful Bidder shall submit a complete statement of his financial resources and his previous experience in similar work.

Guarantee of Work

All workmanship, equipment and materials, furnished or installed by the Contractor shall be guaranteed for a period represented in the applicable specification of system in question against faulty workmanship or defective materials. The warranty period shall begin on the date of substantial completion and acceptance of the project by the Owner and extend for a minimum period of 365 days thereafter. Warranty periods on punch list items shall begin when items are approved as corrected.

Maintenance Support

Within ten days of the date of Substantial Completion of the project, deliver to the Owner two (2) copies of the manufacturer's printed instructions regarding care and maintenance of equipment / systems.

Final Clean-Up

Upon completion of the work and before acceptance and final payment is made, the Contractor shall clean and remove from the site of the work all brush, trash, surplus and discarded materials, temporary services, materials and debris of every kind. The Contractor shall leave the site of the work in a neat and orderly condition equal to that which originally existed. Waste materials removed from the site shall be disposed of at locations satisfactory to the project architect / engineer and shall be considered incidental to the bid.

Correction of Work before Final Payment

The Contractor shall promptly remove from the premises all materials and work condemned by the Owner/Consultant as failing to meet Contract requirements, whether incorporated in the work or not. The contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner and shall bear the expense of making "good" all work of other contractors destroyed or damaged by such removal or replacement.

If the Contractor does not take action to remove such condemned materials and work within 10 days after written notice, the Owner may remove them and may store the material at the expense of the Contractor. If the Contractor does not pay the expense of

such removal and storage within ten days' time thereafter, the Owner may, upon ten days' written notice, sell such materials at auction or at private sale and shall pay the Contractor any net proceeds thereof, after deducting all costs and expenses that should have been borne by the Contractor.

Project Description, Products and Installation

The proposed work will take place at the Harlingen High School campuses described within the project manual. The proposed improvements are exterior site improvements. The major items are stated below and described upon the attached plan sheets.

All prospective contractors are encouraged to visit the sites in order to properly gauge the proposed improvements. It is expected that the contractor will work closely with the Owner as the improvements are planned and construction activities progress.

SECTION 00811

SUPPLEMENTARY CONDITIONS

PART 1: GENERAL:

1.01 SUPPLEMENTARY CONDITIONS:

- A. The Supplementary Conditions modify, change, delete from or add to the General Conditions and shall apply to each and every Section of the Work as though written in full therein.
- B. The following paragraphs and subparagraphs take precedence over the General Conditions. Where any part of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered provisions remain in effect.
- C. Paragraph numbers and titles refer to like numbers and titles in the General Conditions.

1.2 EXECUTION, CORRELATION AND INTENT

Add the following subparagraphs.

- 1.2.4 Scope paragraphs placed at the beginning of the SECTIONS present a brief indication of the principal Work included in that SECTION, but do not limit Work to subject mentioned nor purport to itemize Work that may be included.
- 1.2.5 The Relation of Specifications and Drawings shall be equal in authority and priority. Should they disagree in themselves, or with each other, bids shall be based on the most expensive combination of quality and quantity of work indicated. The appropriate Work, in the event of the above mentioned disagreements, shall be determined by the Architect, at no additional cost to the Owner.
- 1.2.6 Failure to report a conflict in the Contract Documents, prior to opening of Proposal, shall be deemed evidence that the Contractor has elected to proceed in the more expensive manner, at no additional cost to the Owner.
- 1.2.7 The Specifications have been partially "streamlined" and some words and phrases have been intentionally omitted. Missing portions shall be supplied by inference as with notes on drawings.
- 1.2.8 The words "approved", "inspected", "directed", "selected", and similar words and phrases shall be presumed be followed by "Architect". The words "satisfactory", "submitted", "reported", and similar words and phrases shall be presumed to be followed by "to Architect". Words like "install", "provide", "locate", "furnish", and "supply" shall be construed to include complete furnishing and installing of construction. Words like "Bids", "Bidders", may be construed to be "Proposals", "Proposers" or "offers", "offerors", respectively.

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete 2.2.5 and replace with the following subparagraph.

- 2.2.5 The General Contractor will be furnished, free of charge, *fifteen (15)* sets of Drawings and Specifications for use in construction of this Project. Additional Drawings and Specifications will be furnished the General Contractor at the Contractor's expense, but shall remain the property of the Architect. Cost of additional sets will be the cost of reproduction. General Contractor shall use one set to be submitted with closing documents as "as-built" set. This set shall reflect as-built conditions as noted in Section 01720 Paragraph 1.01 B.

3.4 LABOR AND MATERIALS

Add the following subparagraphs 3.4.4 and 3.4.5 to 3.4:

- 3.4.4 After the Contract has been executed, the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 1 of the Specifications).
- 3.4.5 By making requests for substitutions based on subparagraph 3.4.4 above, the Contractor:
1. Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified; Including cost and quality.
 2. Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;
 3. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work , and related work, to be complete in all respects at no additional cost to the Owner.

7.3 CONSTRUCTION CHANGE DIRECTIVES /CHANGE ORDERS

7.3.3.1 CHANGE TO READ:

Mutual acceptance of a lump sum properly itemized in accordance with 7.3.6.1, 7.3.6.2 and 7.3.6.3. Items listed in 7.3.6.4 and 7.3.6.5 shall be a part of the overhead scheduled in 7.3.10 following. Items shall be supported by sufficient substantiating data to permit evaluation;

7.3.6 In the first sentence, delete the words "a reasonable allowance for overhead and profit" and substitute "an allowance for overhead and profit in accordance with Clauses 7.3.10.1 through 7.3.10.6 following:

7.3.6.4 DELETE the final "and" then add the following to the sentence: "are a part of overhead scheduled in 7.3.10 following".

7.3.6.5 ADD the following to the sentence: "are a part of overhead scheduled in 7.3.10 following".

ADD the following subparagraph 7.3.10 to 7.3:

- 7.3.10 In subparagraph 7.3.6, the allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:
1. For the Contractor, for Work performed by the Contractor's own forces, 10 percent of the cost.
 2. For the Contractor, for Work performed by the subcontractor, 6 percent of the amount due the Subcontractor.
 3. For each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's or Sub-subcontractor's own forces, 10 percent of the cost.
 4. For each Subcontractor, for Work performed by the Subcontractor's, Sub-subcontractor's, 6 percent of the amount due the Sub-subcontractor.
 5. Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.6.
 6. **In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization.**

8.1 DEFINITIONS

Add the following subparagraph.

8.1.5 The term working Day as used in the Contract Documents for extensions of time shall mean normal working day excluding weekends and legal holidays.

8.3 DELAYS AND EXTENSIONS OF TIME

Delete paragraph 8.3.2 and replace with the following subparagraph.

8.3.2 Any claim for extension of time shall be made in writing to the Architect not more than ten (10) days after the commencement of the delay; otherwise, it shall be waived. In case of a continuing delay only one claim is necessary. In case of claims for extensions of time because of adverse weather, such extensions of time shall be granted only when such adverse weather prevented the execution of major items of Work on normal working days and exceeds the number of days included in the Contract time. Claim shall include respective daily construction progress report and construction photographs to support cost of claim. The Contractor shall provide an estimate of the probable effect of such delay on the progress of the Work. In the event an extension of time is granted such extension shall be the complete claim allowed. Contractor shall not be entitled to additional compensation such as, but not limited to, compensable extended overhead or lost profit.

9.6 PROGRESS PAYMENTS

Add the following subparagraph to 9.6.1

.1 Unless otherwise indicated in the Agreement, the Owner will pay ninety-five (95%) percent of the amount due the Contractor on account of progress payments until final payment.

Add the following paragraphs 9.11 to Article 9:

9.11 LIQUIDATED DAMAGES:

9.11.1 If the Contractor neglects, fails or refuses to complete the Work within the time specified in the Contract, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration of the awarding of this Contract, to pay the Owner the amount of **ONE-THOUSAND DOLLARS (\$1,000.00)** not as a penalty but as liquidated damages for such breach of Contract as hereinafter setforth, for each and every *calendar day* that the Contractor shall be in default after the time stipulated in the Contractor for completing the Work.

9.11.2 The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would, in such event, sustain.

11.1 Article 11.1 Modify to include the following: The last sentence of paragraph 11.1.3

The Contractor shall furnish three (3) copies of insurance certificates to the Architect's office two (2) days after award of the project and before signing of the contract. The Certificate of Insurance shall include thirty (30) Day Notice of Cancellation; Architect and Owner shall receive the same notice in regard to any policy changes.

Owner and Architect shall be named as additional insured by the Contractor but not with respect to payment of premiums due under Contractor's policies. Coverage shall include any off-site work on adjacent public or private property.

Insurance Company/Carrier issuing the certificates must be listed by A.M. Best and have an "A" rating or better and based in the United States Mainland.

The insurance as required in Article 11.1 shall have "Minimum Limits" as follows:

- A. **WORKER'S COMPENSATION INSURANCE:** Statutory Requirements -
 - 1. All States Endorsements (Broad)
 - 2. Voluntary Compensation
 - 3. Waiver of Subrogation Endorsement

SECTION 00811
SUPPLEMENTARY CONDITIONS

- B. MINIMUM EMPLOYER'S LIABILITY: \$100,000/\$100,000/\$500,000
- C. COMPREHENSIVE GENERAL LIABILITY INSURANCE MINIMUM LIABILITY AND COVERAGE:
 - 1. Bodily Injury \$500,000 each person/\$500,000 each occurrence
 - 2. Property Damage \$100,000 each occurrence/\$100,000 aggregate
 - OR - \$500,000 Combined Single Limit Per Occurrence Bodily Injury and Property Damage.
 - a. Premises and operations coverage
 - b. Explosion and collapse hazard coverage
 - c. Underground hazard coverage
 - d. Products/completed operation hazard coverage with limits and coverage continuing one (1) year after job completion
 - e. Broad Form property damage coverage
 - f. Personal injury coverage
 - g. Waiver of subrogation endorsement
 - h. Contractual liability (Broad Form) coverage
 - i. Independent contractors coverage (Owners, Architects, and Contractors protective)

NOTE: If General Liability coverage is written on a "Claims Made" basis, the Certificate of Insurance should so indicate. If so written, Contractor agrees that coverage so certified beyond job completion and that coverage written will apply to claims made DURING CONSTRUCTION AND FOR ONE (1) YEAR THEREAFTER.

- D. AUTOMOBILE LIABILITY INSURANCE with minimum limits of:
 - 1. Bodily Injury: \$250,000 each person/\$500,000 each occurrence
 - 2. Property Damage: \$250,000 each occurrence/\$500,000 Combined Single Limit per Occurrence Bodily Injury and Property Damage.
 - 3. Automobile Liability Insurance shall include coverage for owned, non-owned, and hired vehicles with limits not less than shown above.
- E. OWNER'S AND CONTRACTOR'S PROTECTIVE LIABILITY:
 - 1. Bodily Injury \$500,000 Single limit each occurrence
 - 2. Property Damage \$250,000 each occurrence/\$250,000 aggregate
- F. UMBRELLA LIABILITY:
Minimum combined single limits **\$2,000,000** with same inception and expiration dates as underlying liability policies and with coverage no less broad than in primary program.
- G. BUILDER'S RISK INSURANCE:
The Contractor shall FURNISH, PAY FOR and issue a Certificate of Builder's Risk Coverage to the Owner/Architect in accordance with the General Conditions and Conditions of the Contract.
- H. ARTICLE 11.4: PERFORMANCE BOND AND PAYMENT BOND:
Delete in its entirety and substitute the following:

- 11.4.1: Prior to signing of the Contract, the CONTRACTOR, at HIS/HER OWN EXPENSE, shall furnish a Performance Bond, and a Labor and Materials Payment Bond for one hundred (100%) percent of the Contract price on such form and with such sureties as the Owner may approve. **Surety company furnishing the Bond must be listed by A.M. BEST and have an "A" rating or better and be based in the United States Mainland and authorized to provide such bonds on public work in the State of Texas.**

Any Payment Bond and Performance Bond furnished pursuant to the provisions of Art. 5160, Vernon's Texas Civil Statutes, connected with this project, shall be furnished by a corporate surety or corporate or corporate sureties in accordance with Article 7.19-1, Vernon's Texas Insurance Code, that has a stated capital and surplus (as reported by it to the Texas Insurance Commission in its most recent report) that is in excess of ten times the stated amount of the Payment bond or the Performance Bond. Provided however, that if any Payment Bond or

SECTION 00811
SUPPLEMENTARY CONDITIONS

any Performance Bond is in an amount in excess of ten percent (10%) of the surety company's capital and surplus (as reported to the Texas Insurance Commission in its most recent report), as a condition to accepting the bond, the Owner must receive written certification and information, satisfactory in form and substance to the Owner, that the surety company has reinsured the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus, with one or more reinsurers who are duly authorized, accredited or trusted to do business in the State of Texas. For the purpose of this requirement, any amount reinsured by any reinsurer may not exceed ten percent (10%) of the reinsurer's capital and surplus (as reported to the Texas Insurance Commission by the reinsurer in its most recent report). In the event there is one or more reinsurer, the surety company must provide all necessary information and certification related to the current financial condition of the surety company and any and all reinsurers required by the Owner, together with copies of all reinsurance contracts with the surety company, before any such Payment Bond and Performance Bond is eligible to be considered acceptable by the Owner.

END OF SECTION

SECTION 00900

ADDENDUM AND MODIFICATIONS

PART 1: GENERAL:

1.01 All issued Addenda and Modifications to the Contract Documents shall be inserted immediately following this page.

1.02 INDEX OF ADDENDA:

No.	Issue Date	General Description
1		
2		
3		
4		
5		
6		

1.03 INDEX OF MODIFICATIONS:

No.	Issue Date	General Description
1		
2		
3		
4		
5		
6		

END OF SECTION

SECTION 01020

ALLOWANCES

PART 1: GENERAL:

1.01 GENERAL:

- A. Include in the Contract Sum the following allowances and cause the work so covered to be performed in accordance with the Contract Documents.
- B. Refer to Conditions of the Contract for general requirements with regard to allowances. Allowance sum covers materials delivered to the job site only, unless otherwise indicated.
- C. Allowance money may, if required, be returned to the Owner by Change Order for purpose of payment for materials or services specified.
- D. Where allowance is indicated as a cost, this is to establish the quality of material, and Contractor shall be responsible for ascertaining the total quantity required, including waste, necessary to complete the installation.
- E. The amount of each allowance includes:
 - 1. The cost of the Contractor of materials and equipment delivered to the site.
 - 2. All required taxes, unless exempt from State sales tax.
 - 3. Labor required under the allowance, only when labor is specified to be included in the allowance.
 - 4. Respective overhead and profit per Section 00811, Paragraph 7.3.10.
- F. In addition to the amount of each allowance, include in the Contract sum an amount of 6% of the Allowance as Contractor's cost for:
 - 1. Handling at the Site; including unloading, uncrating, and storage.
 - 2. Labor for installation and finishing, except where labor is specified to be a part of the Allowance.
 - 3. Protection from the elements and from damage.
 - 4. Other expenses contemplated or required for stated allowance.
 - 5. Contractor's overhead and profit per Section 00811 paragraph 7.3.10.2.

1.02 CONTINGENCY ALLOWANCE:

- A. Include in the Contract Sum a lump sum CONTINGENCY ALLOWANCE of **THREE HUNDRED THOUSAND (\$300,000.00) DOLLARS** including respective labor.
- B. At the closeout of Contract, balance of monies remaining in the CONTINGENCY ALLOWANCE and applicable contractor's cost of 6% of the Contingency Allowance balance will be credited to the Owner by Change Order.

1.03 LANDSCAPE ALLOWANCE:

- A. Include in the Contract Sum a lump sum LANDSCAPE ALLOWANCE of **THIRTY THOUSAND (\$30,000.00) DOLLARS** including respective labor.
- B. At the closeout of Contract, balance of monies remaining in the LANDSCAPE ALLOWANCE and applicable contractor's cost of 6% of the Contingency Allowance balance will be credited to the Owner by Change Order.

SECTION 01020
ALLOWANCES

1.03 GRAPHICS ALLOWANCE:

- A. Include in the Contract Sum a lump sum GRAPHICS ALLOWANCE of ONE - HUNDRED THOUSAND (\$100,000.00) DOLLARS including respective labor.
- B. At the closeout of Contract, balance of monies remaining in the GRAPHICS ALLOWANCE and applicable contractor's cost of 6% of the Contingency Allowance balance will be credited to the Owner by Change Order.

END OF SECTION

SECTION 01045

CUTTING AND PATCHING

PART 1: GENERAL:

1.01 DESCRIPTION:

- A. Contractor shall be responsible for all cutting, fitting and patching, including attendant excavation and backfill, required to complete the Work and to make its several parts fit together properly.

1.02 SUBMITTALS:

- A. Submit a written request to Architect well in advance of executing any cutting or alteration which affects the structural value or integrity of any structural element of the Project. Obtain Architect's approval prior to executing any of the foregoing.

PART 2: PRODUCTS:

2.01 MATERIALS:

- A. Comply with applicable specifications section for each specific product involved.

PART 3: EXECUTION:

3.01 INSPECTION:

- A. Report unsatisfactory or questionable conditions to the Architect in writing; do not proceed with the work until the Architect has provided further instructions.

3.02 PREPARATION:

- A. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the Work.
- B. Provide devices and methods to protect other portions of the Project from damage.
- C. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water.

3.03 PERFORMANCE:

- A. Execute cutting by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.
- C. After installation of the Work, carefully fit around, close up, repair, patch and/or point up all such work to match adjoining surface by use of proper tools and materials and by skilled workmen to which the work belongs.
- D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- E. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.
- F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes. For continuous surfaces, refinish to nearest intersection. For an assembly, refinish the entire unit.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1: GENERAL:

1.01 GENERAL:

- A. The Contractor shall, at his expense, engage a Texas licensed Surveyor, to locate all surveyor marks, including bench marks in order that the exact lines of the property, building and grades will be determined and verified.
- B. Surveyor shall layout out entire Project prior to start of construction.
- C. On completion of foundation walls and major site improvements, the Surveyor shall furnish a certified plat verifying property lines and building lines in accordance with the plot plan.
- D. Any discrepancies arising in locating the work in respect to property and building lines shall be reported immediately to the Owner and the Architect.
- E. Locate and protect control points prior to starting work, and preserve all permanent reference points during construction. Replace project control points which may be lost or destroyed.
- F. Establish a minimum of two permanent bench marks on the site, referenced to data established by survey control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- G. Establish all construction lines and levels, by instrumentation and similar appropriate means.

END OF SECTION

SECTION 01085

APPLICABLE STANDARDS

PART 1: GENERAL:

1.01 DESCRIPTION:

A. Work Included:

1. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
2. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is the Contractor's responsibility to provide materials and workmanship which meet or exceed the specifically named code or standard.
3. It is also the Contractor's responsibility, when so required by the Contract Documents or by written request from the Architect, to deliver to the Architect all required proof that the materials or workmanship, or both, meet or exceed the requirements of the specifically named code or standard. Such proof shall be in the form requested in writing by the Architect, and generally will be required to be copies of a certified report of tests conducted by a testing agency approved for that purpose by the Architect.

B. Related Work Described Elsewhere:

Specific naming of codes or standards occurs on the Drawings and in other Sections of these specifications.

1.02 QUALITY ASSURANCE:

A. Familiarity with pertinent codes and standards: In procuring all items used in this work, it is the Contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured for use in this work meet or exceed the specified requirements.

B. Rejection of non-complying items: The Architect reserves the right to reject items incorporated into the work which fail to meet the specified minimum requirements. The Architect further reserves the right, and without prejudice to other recourse the Architect may take, to accept non-complying items subject to an adjustment in the Contract Amount as approved by the Architect and the Owner.

C. Applicable standards listed in these specifications include, but are not necessarily limited to, standards promulgated by the following agencies and organizations:

1. AASHTO = American Association of State Highway and Transportation Officials, 341 National Press, Washington, D.C. 20004
2. ACI = American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48129
3. AISC = American Institute of Steel Construction, Inc., 1221 Avenue of the American, New York, New York 10020.
4. ANSI = American National Standards Institute (successor to USASI and ASA), 1430 Broadway, New York, New York 10018.
5. ASTM = American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
6. AWS = American Welding Society, Inc., 2501 N.W. 7th Street, Miami, Florida 33125.
7. AWWA = American Water Works Association, Inc., 6666 West Quincy Avenue, Denver, Colorado 80235.
8. CRSI = Concrete Reinforcing Steel Institute, 228 North LaSalle Street, Chicago, Illinois 60610.
9. CS = Commercial Standard of NBS, U.S. Department of Commerce, Government Printing Office, Washington, D.C. 20402.

SECTION 01085
APPLICABLE STANDARDS

10. FGMA = Flat Glass Marketing Association, 3310 Harrison, Topeka, Kansas 66611
11. NAAMM = National Association of Architectural Metal Manufacturers, 1033 South Boulevard, Oak Park, Illinois 60403.
12. NEC = National Electrical Code (see NFPA).
13. NEMA = National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017.
14. NFPA = National Fire Protection Association, 470 Atlantic Avenue, Boston, Massachusetts 02210.
15. SDI = Steel Deck Institute, 135 Addison Avenue, Elmhurst, Illinois 60125.
16. SSPC = Steel Structures Painting Council, 4400 5th Avenue, Pittsburgh, Pennsylvania 15213.
17. TCA = Tile Council of America, Inc., P.O. Box 326, Princeton, New Jersey 08540.
18. UL = Underwriter's Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois 60611.
19. FED SPECS and FED STANDARDS:
Specifications Sales (3FRI), Bldg. 197, Washington Navy Yard, General Services Administration, Washington, D.C. 20407.
20. INTERNATIONAL BUILDING CODE 2006 or latest edition.
21. NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS:/CURRENT EDITION
22. INTERNATIONAL PLUMBING CODE – 2006 or latest edition.
23. ANSI A 17.1, -Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks; and Supplement ANSI A17.1a, current edition.
24. American Society of Heating, Refrigerating and Air Conditionings Engineers ANSI/ASHREA/IES Standard 90.1-2010- Energy Conservation in New Building Design, current edition.
25. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHREA)-Standard No.52- - Methods of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter , current edition.
26. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHREA)-Handbook of Applications, current edition.
27. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHREA)-Handbook of Fundamentals, current edition.
28. American Society for Testing and Materials (ASTM)-Standard No.E 84- Method of Test for Surface Burning Characteristic of Building Materials, current edition.
29. INTERNATIONAL MECHANICAL CODE – 2006 or latest edition.
30. National Bureau of Standards (NBS) (available through GPO - Technical No.#708 - Appendix II, GPO SD Catalog No. C13.45, 708, NTIS COM:72:50062-Inner Laboratory Evaluation of Smoke Density Chamber. Appendix II-Test Method for Measuring the Smoke Generation Characteristics of Solid Materials.
31. Underwriter's Laboratories, Inc. (UL) - Standard No.181, - Factory Made Air Duct Material and Air Duct Connectors.
32. State Purchasing and General Services Commission-Commission's Rules and Regulations for the Elimination of Architectural Barriers.
33. Texas Department of Licensing and Regulation, Texas Architectural Barriers Act.

END OF SECTION

SECTION 01085-2

SECTION 01152

APPLICATIONS FOR PAYMENT

PART 1: GENERAL:

1.01 GENERAL:

- A. Submit Applications for Payment to Architect for each site in accordance with the schedule established by Conditions of the Contract and Agreement Between Owner and Contractor.
- B. Submit itemized applications typed on AIA DOCUMENT G702, Application and Certificate for Payment, and continuation sheets G703 (**as provided in Section 00820**). To purchase original forms call the LRGV/AIA office at 956-994-0939.
- C. *Application for payment shall also be accompanied by a written notarized statement from the surety confirming that the surety has reviewed the application for payment and approves, without reservation, of its payment by the Owner.*

1.02 PREPARATION OF APPLICATION:

- A. Application Form:
 - 1. Fill in required information, including that for Change Orders executed prior to the date of submittal of application.
 - 2. Fill in summary of dollar values to agree with the respective totals indicated on the continuation sheets.
 - 3. Indicate percentage of retainage for completed work and for stored materials as agreed upon in the Owner-Contractor Agreement.
 - 4. Execute notarized certification with the signature of a responsible officer of the Contract firm.
- B. Continuation Sheets:
 - 1. Fill in total list of all scheduled component items of Work, with item number and the scheduled dollar value for each item.
 - 2. Fill in the dollar value in each column for each scheduled line item when work has been performed or products presently stored.
 - a. Round off values to nearest dollar, or as specified for the Schedule of Values.
 - 3. List each Change Order executed prior to the date of submission, at the end of the continuation sheets unless otherwise agreed upon.
 - a. List each Change Order Number, and description, as for an original component item of work unless it is agreed that the schedule of values should be revised.
- C. Construction Schedule:
 - 1. **Provide original construction schedule with first application for payment.**
 - 2. **With subsequent applications provide updated construction schedule indicating deviations from original construction schedule.**

1.03 SUBMITTAL PROCEDURE:

- A. Submit three {3} copies of Applications for Payment to Architect at the times stipulated in the Agreement.
- B. When Architect finds the Application properly completed and correct, he will transmit a certificate of payment to Owner. If an adjustment in the requested amount is made, he will advise the Contractor in writing.

END OF SECTION

SECTION 01153

CHANGE ORDER PROCEDURES

PART 1: GENERAL:

1.01 PROPOSED CHANGES:

- A. Upon discovery of circumstances or conditions leading to the conclusion that a construction change should be made, the Architect will issue a Request for Change Order Proposal (R.F.P.) form.
- B. Any work done by Contractor not authorized by the Owner shall be subject to removal at the Contractor's expense.
- C. Upon determination that a proposed change appears feasible, the Architect will assign a R.F.P. number and log the information. The Architect will then prepare necessary drawings, specifications or descriptions as required for pricing.
- D. The Architect will forward the package to the Contractor for pricing. Typically, ten (10) working days will be allowed for pricing; however, additional time will be allowed for more extensive changes.
- E. **The Contractor shall submit his price proposal along with all required back-up information to the Architect. The submittal shall include separate breakdowns for general contract and subcontract work.**
- F. **The breakdowns shall show materials by quantities and unit prices. Cost including labor, tax, insurance mark-ups, and equipment costs. Overhead and profit shall be shown separately. Quotation shall include all costs. No additional costs will be allowed for a proposed change.**
- G. The Contractor's proposed change quotations will be reviewed by the Architect within a reasonable amount of time, usually not more than ten (10) working days. Conformance with the contract and the proposed change documents, as well as material, labor and equipment quantities and costs, and allowed mark-up percentages will be verified. Requests for additional time will also be evaluated based on the contractor's written evidence submitted along with a revised construction schedule proving impact on final completion date. Lack of such written evidence shall cause the request for time extension to be rejected. In case of differences, discrepancies, errors, etc. the Contractor will take action to obtain necessary revisions or corrections to the quotation.
- H. "Cost of Doing business" items such as, but not limited to, supervision, field and home office expenses, warranty reserve, clean-up, and expendable supplies are a part of the overhead expense and as such shall not be included as a part of the change order proposal.
- I. Bond premiums may be included as an expense item in an additive R.F.P. if also included in a deductive R.F.P. Percentage allowed shall be limited to actual percentage paid by General Contractor to bonding agent. Premiums for subcontractor bonds, if required by General Contractor, shall not be passed on the Owner.
- J. When a price quotation has been considered acceptable, the Architect will forward his recommendations and all back-up information to the Owner. A recommendation either for or against the proposed change will accompany this submittal from the Architect.

1.02 AUTHORIZATION FOR CONSTRUCTION TO PROCEED:

- A. Within a reasonable time, the Owner will notify the Architect whether the change will be implemented. If the change is approved, the Architect will issue a Change Order. The Change Order may be issued, at the Architect's discretion, immediately or in conjunction with several other approved RFP's if considered appropriate.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. Contractor shall schedule and administrate pre-construction meeting, monthly progress meetings, and specially called meetings throughout the progress of the work.
 - 1. Prepare agenda for meetings.
 - 2. Distribute written notice of each meeting and the agenda four (4) working days in advance of meeting date.
 - 3. Make physical arrangements for meetings.
 - 4. Preside at meetings.
 - 5. Record the minutes; include all significant proceedings and decisions.
 - 6. Reproduce and distribute copies of minutes within three (3) working days after each meeting.
- B. Representative of contractors, subcontractors and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. Architect's and Owner's Representative may attend meetings.

1.02 PRE-CONSTRUCTION MEETING:

- A. Schedule within fifteen (15) days after date of Notice to Proceed.
- B. Location: **Harlingen CISD – District Operation
Main Conference Room**
- C. Attendance:
 - 1. Owner's Representative.
 - 2. Architect and his professional consultants.
 - 3. Contractor's Superintendent.
 - 4. Major Subcontractors.
 - 5. Others as appropriate.

1.03 PROGRESS MEETINGS:

- A. Schedule regular monthly meetings at **a scheduled time** on an agreed upon date of each month.
- B. Hold called meetings as required by progress of the Work.
- C. Location of the meetings: **on site**.
- D. Attendance:
 - 1. Architect and his professional consultants as needed.
 - 2. Subcontractors as appropriate to the agenda.
 - 3. Suppliers as appropriate to the agenda.
 - 4. Others as appropriate.

END OF SECTION

SECTION 01300

SUBMITTALS AND SUBSTITUTIONS

PART 1: GENERAL:

1.01 DESCRIPTION:

A. Work Included:

1. Wherever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined by manufacturer's name and catalog numbers, reference to recognized industry and government standards, or description of required attributes and performance.
2. To ensure that the specified products are furnished and installed in accordance with design intent, procedures have been established for advance submittal of design data and for their review by the Architect.
3. Make all submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements. Submittals should include cut sheets of original specified items.
4. Product substitutions request shall be submitted no later than 72 hours prior to opening of Bids (Proposals) as noted in Section 00020.

B. Related Work Described Elsewhere: Individual requirements for submittals are described in pertinent other Sections of these Specifications.

1.02 QUALITY ASSURANCE:

A. Coordination of Submittals: Prior to each submittal, carefully review and coordinate all aspects of each item being submitted and verify that each item and the submittal for it conforms in all respects with the requirements of the Contract Documents. By affixing the Contractor's signature to each submittal, Contractor certifies that this coordination has been performed. Contractor shall approve all submittals prior to submission to Architect. Contractor shall verify all dimensions and conditions on the job.

B. Certificate of Compliance:

1. Certify that all materials used in the work comply with all specified provisions thereof. Certification shall not be construed as relieving the Contractor from furnishing satisfactory materials if, after tests are performed on selected samples, the material is found to not meet specified requirements.
2. Show on each certification the name and location of the work, name and address of Contractor, quantity and date or dates of shipment or delivery to which the certificate applies, and name of the manufacturing or fabricating company. Certification shall be in the form of letter or company-standard forms containing all required data. Certificates shall be signed by an officer of the manufacturing or fabricating company.
3. In addition to the above information, all laboratory test reports submitted with Certificates of Compliance shall show the date or dates of testing, the specified requirements for which testing was performed, and results of the test or tests.

1.03 SUBMITTALS:

- A. Submittals Schedule: Provide submittal schedule with first Application for Payment , and before any items are submitted for approval, submit to the Architect two copies of the schedule described in Article 2.01 of this Section.
- B. Certification of Compliance: Upon completion of the Work, and as a condition of its acceptance, submit to the Architect all Certificates of Compliance.
- C. Procedures: Make submittals in strict accordance with the provisions of this Section.

PART 2: PRODUCTS:

2.01 SUBMITTAL SCHEDULE:

- A. General: Compile a complete and comprehensive schedule of all submittals anticipated to be made during progress of the work. Include a list of each type of item for which Contractor's drawings, shop drawings, Certificates of Compliance, material samples, guarantees, or other types of submittals are required. Upon approval by the Architect this schedule will become part of the Contract and the Contractor will be required to adhere to the schedule except when specifically otherwise permitted. **Submittals will not be processed & reviewed until schedule is received.**
- B. Coordination: Coordinate the schedule with all subcontractors and materials suppliers to ensure their understanding of the importance of adhering to the approved schedule. Coordinate as required to ensure the grouping of submittals as described in Paragraph 3.02 below.
- C. Revisions: Revise and update the schedule on a monthly basis as necessary to reflect conditions and sequences. Promptly submit revised schedule to the Architect for review and comment with each application for payment.
- D. It is the Contractor's responsibility to notify the Architect in writing if and when the submittal not returned from review are going to impact the construction schedule.

2.02 SHOP DRAWINGS AND COORDINATION DRAWINGS:

- A. Shop Drawings:
 - 1. Scale and Measurements: Make all shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the items and its method of connection to the work (construction document drawings shall not be traced, copied or reproduced).
 - 2. Type of Prints Required: Submit two printed copies and one reproducible (vellum) of each submittal.
 - 3. Review of Shop Drawings: All review comments of the Architect will be shown on the reproducible drawings when it is returned to the Contractor. The Contractor shall be responsible for making all copies required for his purpose and distributing them to the subcontractors & suppliers.
 - 4. Failure to submit one printed & one reproducible copy will cause the submittal to be returned unchecked.

2.03 MANUFACTURERS' LITERATURE:

- A. General: Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, **clearly indicate which portion of the contents is being submitted for review. Highlight pertinent information with green highlighter.**

- B. Number of Copies Required: *Submit number required by the general contractor for construction plus one copy for architect, one copy for consultants, one copy for owner.* General contractor copies will be returned to the contractor with all review comments of the architect and respective consultant.

2.04 SAMPLES:

- A. Accuracy of Samples: Samples shall be of the precise article proposed to be furnished.
- B. Number of Samples Required: Unless otherwise specified, submit all samples in the quantity which is required to be returned plus two (2) which will be retained by the Architect.
- C. Reuse of Samples: In situations specifically so approved by the Architect, the Architect's retained sample may be used in the construction as one of the installed items.

2.05 COLORS AND PATTERNS:

- A. Unless the precise color and pattern is specifically described in the Contract Documents, and whenever a choice of color pattern is available in a specified product, submit accurate color and pattern charts to the Architect for review and selection.

2.06 SUBSTITUTIONS:

- A. Approval Required:
1. The Contract is based on the standards of quality established in the Contract Documents.
 2. All products proposed for use, including those specified by required attributes and performance, shall require approval by the Architect before being incorporated into the work.
 3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the Architect.
 4. Product substitution requests shall be submitted no later than 72 hours prior to Opening of Bids (Proposals) as noted in Section 00020.
- B. "Or Equal":
1. Where the phrase "or equal" or "or equal as approved by the Architect" occurs in the Contract Documents, do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by the Architect.
 2. The decision of the Architect will be final.
 3. It is the Contractor's responsibility to compare all aspects of the substitute and prove the substitute is equal.
 4. Coordinate submission of submittals with the different submittals related to the parts of Work so that the submittal will proceed according to the submittal schedule.
 5. Processing of submittal which contain finishes for selection will not begin until all related submittals are received.

2.07 DEVIATIONS:

- A. Clearly note, in written form, any deviations from the contract documents.

2.08 COMPLIANCE:

- A. Clearly mark specific items which are submitted in compliance with the contract documents.

PART 3: EXECUTION:

3.01 IDENTIFICATION OF SUBMITTALS:

- A. General: Identify each submittal with specification section number and project name. Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and check of submittals.
- B. Internal Identification: On at least the first page of each copy of each submittal, and elsewhere as required for positive identification, clearly indicate the submittal specification section number in which the item was included.
- C. Resubmittals: When material is resubmitted for any reason, transmit under a "REVISED" letter of transmittal and with a "REVISED" submittal specification section number. (e.g.: 03100 becomes 03100R-1)
- D. Submittal Log: Maintain an accurate submittal log for the duration of the Contract, showing current status of all submittals at all times. Make the submittal log available for the Architect's review upon request.

3.02 COORDINATION OF SUBMITTALS:

- A. Coordinate, prepare, and process submittals in accordance with work to be performed.
- B. General: Prior to submittal for approval, use all means necessary to fully coordinate all materials and work task activities including, but not necessarily limited to:
 - 1. Determine and verify all conditions, catalog numbers, and similar data.
 - 2. Coordinate with other trades as required.
 - 3. Clearly indicate all deviations from requirements of the Contract Documents.
- C. Grouping of Submittals: Unless otherwise specified, make all submittals in groups containing all associated items to ensure that information is available for checking each item when it is received. Partial submittals may be rejected as not complying with the provisions of the Contract Documents and the Contractor shall be strictly liable for all delays so occasioned.

3.03 SUBMITTAL SCHEDULE:

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmitted, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Material Submittal: Submit all material submittals required to maintain orderly progress of the Work and those required early because of long lead-time for manufacture or fabrication or for final color selection.

3.04 TIMING OF SUBMITTALS:

- A. General: Make all submittals far enough in advance of scheduled dates for installation to provide all time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery. Allow time for the above tasks in construction submittal schedule.
- B. Submittal time schedules: Submittals shall be provided to architect for project based on:
- | | |
|--|---|
| <i>3 month to 6 month projected completion</i> | <i>1 month from date of contract for items requiring color selection and 2 months for other items.</i> |
| <i>7 month to 12 month projected completion</i> | <i>2 months from date of contract for items requiring color selection and 3 months for other items.</i> |
| <i>13 month to 16 month projected completion</i> | <i>3 months from date of contract for items requiring color selection and 4 months for other items.</i> |
| <i>over 17 months projected completion</i> | <i>4 months from date of contract for items requiring color selection and 5 months for other items.</i> |
- C. Architect's Initial Review Time: In scheduling, allow at least fifteen (15) working days for initial review by the Architect following receipt of the submittal. Items requiring color coordination will be delayed pending receipt of all items that require color coordination and owner approval.
- D. Consultant's review time: In scheduling allow at least (20) work days for initial review of each submittals.
- E. Delays: Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the Contract completion date.

3.05 ARCHITECT'S REVIEW:

- A. General: Review by the Architect shall not be construed as a complete check, but only that the general method of construction and detailing is satisfactory. Review shall not relieve the Contractor from responsibility for errors which may exist.
- B. Authority to Proceed: The notations "**no exception taken**" or "**make corrections noted**" authorize the Contractor to proceed with fabrication, purchase, or both, of the items so noted, subject to the revisions, if any, required by the Architect's review comments.
- C. Revisions: Make all revisions required by the Architect. If the Contractor considers any required revision to be a change, he shall so notify the Architect as provided for under "Changes" in the General Conditions before proceeding with the work. Show each drawing revision by number, date, and subject in a revision block on the drawing. Make only those revisions directed or approved by Architect.
- D. Revisions after Approval: When a submittal has been reviewed by the Architect, resubmittal for substitution of materials, or equipment, will not be considered.

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULE

PART 1: GENERAL:

1.01 CONSTRUCTION SCHEDULE:

- A. The Contractor shall, within thirty (30) working days after Notice to Proceed, prepare and submit to the Owner and Architect for approval, a practicable Work Schedule, showing the order in which the Contractor proposes to carry on the Work and the time at which the several milestone features will be started and completed.
- B. The Contractor shall incorporate into this analysis that work being performed by each subcontractor so that all work involved is shown in the schedule for the complete project.
- C. Activities shown on the schedule shall consist not only of the actual construction operations, but will include also the submittal of shop drawings and samples, procurement of materials and equipment and installation and testing of major and critical items.
- D. Activities of the Owner that affect the progress, such as approvals and the deliveries of Owner-furnished materials shall also be shown.
- E. Related activities shall be grouped on the schedule for simplification. The selection of activities will be subject to approval by the Owner and Architect.
- F. For each activity there shall be listed an earliest and latest start time, the earliest and latest finish time and the slack time.
- G. During progress of the work, any changes in the original schedule desired by the Contractor must be approved by the Owner and Architect before being put into effect.
- H. When changes in the work are required and directed by the Owner and Architect under applicable paragraphs of this Contract, the original schedule may if required, be revised without delay to incorporate such changes, or new work, and indicate the effect, if any, thereof on the Project as a whole. The cost of such schedule change shall be considered as part of the overhead cost of revised work.
- I. If the Contractor falls behind the original Schedule, the Contractor shall take such steps as may be necessary to improve the progress, which may require the contractor to increase the number of shifts, and/or overtime operation, days of work and/or the amount of construction plant, and to submit for approval revised schedules in the form above in order to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the Owner.

END OF SECTION

SECTION 01320

DAILY CONSTRUCTION PROGRESS REPORT

PART 1: GENERAL:

1.01 GENERAL:

- A. The Contractor shall submit to the Architect upon request, Daily Reports, wherein the following data is provided relative to his work and the Work of his Subcontractors:
1. Location and description of work being performed.
 2. Problems, if any, encountered during the course of the day's work.
 3. Number of personnel on job for Contractor and each Subcontractor (broken down as to the number of journeymen, apprentices, etc.).
 4. Temperature and weather conditions.
 5. Report of any accident or accidents that may have occurred during the reporting period.
 6. General description of delivery of material to be stored on site.

END OF SECTION

SECTION 01330

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1: GENERAL:

1.01 RELATED DOCUMENTS:

A. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY:

A. This Section includes administration and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittal Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.
8. Construction photographs.

B. Related Sections include the following:

1. Division 1 Section Schedule of Values for submitting the Schedule of Values.
2. Division 1 Section "Project meetings" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal and Substitutions" for submitting schedules and reports.
4. Division 1 Section "Testing Laboratory Services" for submitting a schedule of tests and inspections.
5. Division 1 Section "Contract Closeout" for submitting photographic negatives as Project Record Documents at Project closeout.

1.03 DEFINITIONS:

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determined when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

- E. Float the measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.04 SUBMITTALS:

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format.
1. Scheduled date for first submittal.
 2. Specification Section number and title.
 3. Submittal category (action or informational).
 4. Name of subcontractor.
 5. Description of the Work covered.
 6. Scheduled date for Architect's final release or approval.
- B. Contractor's Construction Schedule: The construction schedule shall be in the form of a CPM. Provide the CPM in graphic flow chart format along with reports. Submit two copies of the CPM in printed for and one in reproducible form. Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 3. Total Float Report: List of all activities sorted in ascending order of total float.
- C. Daily Construction Progress Reports: Contractor shall maintain a daily log on the site. It shall be available for review by the Architect and Owner at any time during normal working hours.

The Contractor shall submit to the Architect upon request, Daily Reports, wherein the following data is provided relative to the work and the Work of the Subcontractors:

1. Location and description of work being performed.
2. Problems, if any, encountered during the course of the day's work.
3. Number of personnel on job for Contractor and each Subcontractor (broken down as to the number of journeymen, apprentices, etc.).
4. Temperature and weather conditions.
5. Report of any accident or accidents that may have occurred during the reporting period.
6. General description of delivery of material to be stored on site.

SECTION 01330
CONSTRUCTION PROGRESS DOCUMENTATION

- D. Material Location Reports: Should materials be stored off site for which the contractor is requesting payment, a complete inventory of the material shall be made. Each month the off-site inventory continues to be stored off-site then the report shall be maintained including the description of the material, the location of the material and a certification by the General Contractor that he has inventoried and examined the material at the location and certifies to the correctness of the report. The General Contractor shall accompany the Architect each month to verify the inventory prior to the progress payment.

1.05 COORDINATION:

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

END OF SECTION

SECTION 01370

SCHEDULE OF VALUES

PART 1: GENERAL:

1.01 SUMMARY:

- A. Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.
- B. RELATED WORK:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
 - 2. Preparation and submittal of a Schedule of Values is required by the General Conditions.
 - 3. Schedule of Values is required to be compatible with the "Continuation Sheet" accompanying Applications for Payment, as described in Section 0152.

1.02 SUBMITTAL:

- A. With first Application for Payment, submit a proposed Schedule of Values to the Architect.

1.03 QUALITY ASSURANCE:

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Architect, provide copies of the subcontracts or other data acceptable to the Architect, substantiating the sums described.

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1: GENERAL:

1.01 CONSTRUCTION PHOTOGRAPHS:

- A. Construction progress photographs shall be taken once a month with the time, direction of view and vantage points noted, **and submit to architect at monthly construction meeting.**
- B. Photograph from locations to adequately illustrate the condition of construction and the state of the Project.
 - 1. At successive periods of construction, take at least one photograph from the same overall view as previously and other locations to demonstrate the daily activity of construction please submit photos in electronic format in form of DVD.

END OF SECTION

SECTION 01400

TESTING LABORATORY SERVICES

PART 1: GENERAL:

1.01 DESCRIPTION:

- A. Work Included: Testing includes, but is not necessarily limited to:
 - 1. Soil Compaction
 - 2. Concrete
 - 3. Grout
 - 4. Mortar
 - 5. Structural as indicated in drawings, Sheet S1.2
- B. Related Work Described Elsewhere: Requirements for testing may be described in various specification sections.
- C. Testing Laboratory: The Testing Laboratory will be selected & paid by the **Owner**.

1.02 QUALITY ASSURANCE:

- A. Qualifications of testing laboratory: The laboratory will be qualified in accordance with ASTM E-329-70 "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel Used in Construction".
- B. Codes and Standards: (Testing) In accordance with pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.

1.03 PRODUCT HANDLING:

- A. Promptly process and distribute test reports and related instructions to assure necessary retesting and/or replacement of materials with least possible delay in work.

PART 2: PRODUCTS:

2.01 PAYMENT FOR RETESTING SERVICES:

- A. Retesting: When initial tests indicate non-compliance with Contract Documents, subsequent retesting shall be performed by the same laboratory and costs borne by Contractor.

2.02 CODE COMPLIANCE TESTING:

- A. Inspections and test required by codes or ordinances, or by plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for, by the Contractor.

2.03 CONTRACTOR'S CONVENIENCE TESTING:

- A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

PART 3: EXECUTION:

3.01 COOPERATION WITH TESTING LABORATORY:

- A. Representative of testing laboratory shall have access to Work at all times; provide facilities for such access in order that laboratory may properly perform its functions.

3.02 SCHEDULES FOR TESTING:

- A. Establishing Schedule:
1. Determine with laboratory, time required to perform tests and issue findings.
 2. Provide required time in construction schedule.
- B. Revising Schedule: Coordinate changes of schedule with laboratory as required. Testing Laboratory shall provide a twenty-four (24) hour phone number to enable the Contractor to revise the schedule at times other than regular business hours.
- C. Adherence to Schedule: When laboratory is prevented from testing or taking specimens according to the determined schedule due to incompleteness of work, extra costs attributable to delay may be back charged to Contractor and not borne by Owner.

3.03 TAKING SPECIMENS:

- A. Testing Laboratory shall perform the following services:
1. Take samples and specimens.
 2. Furnish sampling equipment and personnel.
 3. Deliver specimens and samples to laboratory.

END OF SECTION

SECTION 01510

TEMPORARY UTILITIES

PART 1: GENERAL:

1.01 SCOPE:

- A. Furnish, install and maintain temporary utilities required for construction; remove on completion of Work.

1.02 TESTING:

- A. All power, water, light or heat required for testing of Architectural, Structural, Mechanical and Electrical Work shall be paid for by the Contractor.

1.03 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Comply with National Electric Code.
- B. Comply with Federal, State and local codes and regulations and with utility company requirements.

PART 2: PRODUCTS:

2.01 MATERIALS, GENERAL:

- A. Materials and equipment may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING:

- A. Provide connections and temporary metering, size to provide services required for power and lighting; Contractor shall pay for the costs of power used for construction.
- B. Install ground fault interrupting circuit(s) and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords.
- C. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work.
- D. Each Sub-contractor shall provide it's own extension cords and any additional lighting that may be required to complete it's work.
- E. Prior to final inspection remove temporary lamps and install new lamps if permanent fixtures were used for temporary lighting.

2.03 TEMPORARY HEAT AND VENTILATION:

- A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.
- B. Provide adequate forced ventilation of enclosed areas for curing of installed materials to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.

SECTION 01510
TEMPORARY UTILITIES

- C. Portable heaters shall be standard U.L. approved units complete with controls. Pay all costs of installation, maintenance, operation and removal, and for fuel consumed.

2.04 TEMPORARY TELEPHONE SERVICE:

- A. Arrange with local telephone service company, provide direct line telephone service at the construction site for the use of personnel and the Architect.
- B. List telephone with information operator in the name of the Project and in the name of the Contractor.
- C. Pay all costs for installation, maintenance and removal, and service charges for local calls. Contractor may install a pay telephone for sub-contractors use.

2.05 TEMPORARY WATER:

- A. General Contractor shall provide water at site for construction purposes; General Contractor will pay costs of water used for construction.
- B. General Contractor shall provide potable drinking water at the site.

2.06 TEMPORARY SANITARY FACILITIES:

- A. Provide and maintain adequate temporary outside toilet facilities for use of persons working at the Site, same shall be padlocked at all times when no construction personnel are on Site.
- B. Keep toilets clean and in sanitary condition. Provide toilet tissue in suitable holders. Comply with applicable legal, health and OSHA requirements.

2.07 TEMPORARY FIRE PROTECTION:

- A. Observe and enforce throughout the work during the whole period of construction all requirements of the local City and State Fire Marshal and Insurance Authorities to minimize the fire hazard during the progress of the work.

PART 3: EXECUTION:

3.01 GENERAL:

- A. Comply with applicable requirements specified in Division 15 - Mechanical, and in Division 16 - Electrical.
- B. Maintain and operate systems to assure continuous service.
- C. Modify and extend systems as work progress requires.

3.02 REMOVAL:

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installation or use of temporary facilities.
- C. Restore permanent facilities used for temporary services to specified condition.

END OF SECTION

SECTION 01520

CONSTRUCTION AIDS

PART 1: GENERAL:

1.01 SCOPE:

- A. Furnish, install and maintain temporary personnel, traffic and materials handling facilities required for construction; remove on completion of Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Comply with Federal, State and local codes and regulations and with utility company and insurance agencies' requirements.

PART 2: PRODUCTS:

2.01 MATERIALS, GENERAL:

- A. Materials and equipment may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.
- B. Provide and maintain signs to prevent damage or injury. Surround site with signs warning of construction hazards at intervals not greater than 200' apart.
- C. Should it become necessary to remove runways, safety handrails, or other safety items it will be that Contractor's responsibility to replace the runway, safety handrails, or other safety items, immediately in keeping with OSHA standards.
- D. Pay all costs for installation, maintenance relocation and removal, and service charges for rented equipment.

2.02 SCAFFOLDING:

- A. Erect and maintain in a safe manner scaffolding, ramps, runways, platforms, guards, rails, stairs and ladders as necessary for the work.

2.03 LIFTING AND HOISTING:

- A. Provide hoists, temporary elevators, lifts, cranes and towers necessary for expediting the handling of materials.
- B. Install lifting and hoisting equipment to meet applicable safety requirements.

2.04 PUMPING AND DRAINING:

- A. Keep working and storage areas free from water that could cause damage or that would interfere with work.
- B. Do not pump or drain water onto adjacent property. Distribute discharge to prevent excessive erosion.

PART 3: EXECUTION:

3.01 GENERAL:

- A. Maintain and operate systems to assure continuous service.
- B. Modify and extend systems as work progress requires.

3.02 REMOVAL:

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore permanent facilities used for temporary services to specified condition.

END OF SECTION

SECTION 01530

BARRIERS

PART 1: GENERAL:

1.01 FENCING AND BARRICADES:

- A. Provide proper and adequate barricades, runways, safety handrails, fencing or other safety items to protect and provide access in or around the site by other than construction personnel. Non construction personnel must be accompanied by general contractor, architect or architect representative, owner or owner representative.
- B. Provide all vertical shafts with safe, temporary railings and supports, adequately braced.
- C. Cover trenches and holes when not in use. Erect barriers at sharp changes in plane more than 3 feet high.

1.02 CONSTRUCTION FENCE:

- A. Provide a construction fence around the structure and material storage areas to prevent unauthorized entry to the construction site.
- B. Install fence at the beginning of excavation operations and maintain in good condition until removal is approved by the Architect.
- C. Unless otherwise required by local codes or ordinances, construct wire mesh fence a minimum of 8'-0" high with securely anchored line, corner and gate posts.
- D. Provide a minimum number of gates which will be padlocked shut during nonworking hours.
- E. Locate pedestrian entrance gates as required to provide controlled personnel entry, in suitable relation to construction parking facilities.

1.03 REMOVAL:

- A. Completely remove barricades and other safety barriers including foundations, when construction has progressed to the point that they are no longer needed, and when approved by Architect.
- B. Clean and repair damage caused by installation, fill and grade the areas of the Site to required elevations and slopes, and clean the area.

END OF SECTION

SECTION 01580

PROJECT SIGN

PART 1: GENERAL:

1.01 PROJECT SIGN:

- A. Install and maintain one (1) project sign, located as directed, 8 feet by 8 feet.
- B. Construct sign of metal or 3/4" thick exterior grade plywood.
- C. Support sign on a minimum of two 4x4 posts securely embedded and braced to resist wind load.
- D. Letter sign with project data, including: *name of project, Owner representatives, Architect, Engineers and Contractor.*
- E. Provide vinyl 3M printed surface, Architect to provide a digital image.
- F. The Architect will prepare a Drawing indicating lettering, layout and location of the sign.
- G. No other signs or advertising will be permitted on the Site except as noted below.
2 foot x 4 foot signs with contractor's name may be used for directing material delivery or directing of construction traffic or for other safety issues.
- H. Maintain sign in good condition for the duration of the job.

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1: GENERAL:

1.01 FIELD OFFICE:

- A. Provide and maintain a minimum of one field office.
- B. Provide means for locking office when work is not in progress.
- C. Inform Architects, in writing, of the name, address and telephone of person who will have keys to office at all times.
- D. Provide furnishings, lights, telephone, air conditioning, heat and ventilation to permit comfortable use of the office. Field office to be accessible for use by Architect and Owner representatives.

1.02 TRAILERS AND STORAGE:

- A. Provide suitable and sufficient enclosed and covered spaces, with raised flooring to protect materials and equipment subject to damage by weather or construction.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1: GENERAL:

1.01 MANUFACTURER'S INSTRUCTIONS:

- A. When Contract Documents require that installation of work shall comply with manufacturer's instructions, obtain and distribute copies of such instructions to parties involved in the installation, including three (3) copies to the Architect.
 - 1. Maintain one set of complete instructions at the job site during installation and until completion.
- B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.
 - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further instructions.
 - 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.02 DELIVERY OF MATERIALS:

- A. All materials shall be delivered in their original, unopened, containers which shall bear the seal, trademark or hallmark of the respective associations or councils and the identification label of the manufacturer.
- B. The Contractor shall inspect all materials upon their arrival at the job and see that they conform to the requirements of these Specifications and prevent the unloading of unsatisfactory material or promptly remove same from the premises without waiting instruction from the Architect to do so.
- C. Time deliveries and unloading to prevent traffic congestion and blocking of access, and to avoid interferences and delays in work.
- D. Provide for continuity of any phase of work. Sufficient quantities for completion of a phase shall be on the Project Site before that phase is started.
- E. Pack and handle materials to prevent damage during delivery. Store materials at designated locations to avoid interference with work and arrange in order of intended use.

1.03 STORAGE AND PROTECTION:

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
 - 1. Store products subject to damage by the elements in weathertight enclosures.
 - 2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.
- B. Exterior Storage:
 - 1. Store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation.
 - 2. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
- D. After installation provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

END OF SECTION

SECTION 01631

SUBSTITUTIONS AND PRODUCT OPTIONS

PART 1: GENERAL:

1.01 SUBSTITUTIONS:

- A. Bids or proposals shall be based upon providing the specified materials, processed products, persons or organizations, etc., identified in this Specification and/or indicated on the Drawings.
- B. Product substitution requests shall be submitted no later than 72 hours prior to Opening of Bids (Proposals) as noted in Section 00020.**
- C. The burden of proof of equality rests with the Contractor, and supporting technical literature, samples, drawings and performance data must be submitted with each request for substitutions.
- D. The Owner and/or Architect reserve the right to accept or reject proposed substitutions. Each request shall state the amount of savings to the Owner, if the substitution is approved.
- E. Cost of any testing required for analysis of proposed substitution shall be paid for by the Contractor at a testing agency selected and approved by the Architect.
- F. Should a substitution be accepted, the Contractor shall be responsible to make all necessary adjustments in the Work which may be affected as a result of the substitution at no additional cost to the Owner.
- G. Should a substitution be accepted and this substitution prove to be defective within the one year guarantee period, the Contractor shall replace the substituted material with that specified and bear the costs incurred thereby.

1.02 PRODUCT OPTIONS:

- A. Contractor's Options:
 - 1. For Products specified only by reference standard, select any product meeting that standard.
 - 2. For Products specified by naming several products or manufacturers, select any one of the products, or manufacturer's names, which complies with the Contract Documents.
 - 3. For Products specified by naming only one Product or manufacturer, Contractor must submit a request as for substitutions for any Product or manufacturer not specifically named.
 - 4. For Products specified by naming only one Product and manufacturer and indicated as "no substitute", there is no option.
- B. Submit a separate request for each Product Substitution, supported with complete data, with drawings and samples as appropriate, including:
 - 1. Comparison of the qualities of the proposed substitution with that specified.
 - a. Cutsheets & supporting data of specified product.
 - b. Cutsheets & supporting data of proposed product substitution.
 - 2. Changes required in other elements of the work because of the substitution.
 - 3. Effect on the Construction Schedule.
 - 4. Cost data comparing the proposed substitution with the Product specified.
 - 5. Any required license fees or royalties.
 - 6. Availability of maintenance service, and source of replacement materials.

SECTION 01631
SUBSTITUTIONS AND PRODUCT OPTIONS

- C. A request for a substitution constitutes a representation that Contractor:
1. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified.
 2. Will provide the same warranties or bonds for the substitution as for the Product specified.
 3. Will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work complete in all respects.
 4. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
- D. Architect will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1: GENERAL:

1.01 REQUIREMENTS:

- A. Comply with requirements stated in Conditions of Contract and in Specifications for administrative procedures in closing out the Work.
- B. Related requirements in other parts of the Project Manual:
 - 1. Fiscal provisions, legal submittals and additional administrative requirements: Conditions of the Contract.
- C. Related requirements specified in other Sections:
 - 1. CLEANING: Section 01710.
 - 2. PROJECT RECORD DOCUMENTS: Section 01720
 - 3. OPERATING AND MAINTENANCE DATA: Section 01730
 - 4. WARRANTIES AND BONDS: Section 01740
 - 5. CONTRACTOR'S ASBESTOS FREE AFFIDAVIT: Section 01800
- D. Provide 5 DVD copies containing PDF files, organized in a PDF portfolio with index, containing all pertinent information in this section and related sections.

1.02 SUBSTANTIAL COMPLETION:

- A. When Contractor considers the Work is substantially complete, he shall submit to Architect, written notice that the Work, or designated portion thereof, is substantially complete and include a list of items (Contractor's punchlist) that have already been addressed.
- B. Within a reasonable time after receipt of such notice, Architect will review the work to determine the status of completion.
- C. Should Architect determine that the work is not substantially complete:
 - 1. Architect will promptly notify the Contractor in writing, giving the reasons therefore including list of items to be completed or corrected.
 - 2. Contractor shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the Architect.
 - 3. Architect will re-review the Work.
- D. When Architect concurs that the Work is substantially complete, the architect will:
 - 1. Prepare a Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected, as verified and amended by the Architect.
 - 2. Submit the Certificate to Owner and Contractor for their written acceptance of the responsibilities assigned to them in the Certificate.

1.03 CONTRACTOR CERTIFICATION OF FINAL COMPLETION:

- A. When Contractor considers the Work is complete, he shall submit **written certification** that:

SECTION 01700
CONTRACT CLOSEOUT

1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
 5. Work is completed.
- B. Architect will review the work to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should Architect consider that the Work is incomplete or defective:
1. Architect will promptly notify the Contractor in writing, listing the incomplete or defective work.
 2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Architect that the Work is complete.
 3. Architect will re-inspect the Work.
- D. When the Architect finds that the Work is acceptable under the Contract Documents, the architect shall request the Contractor to make closeout submittals.

1.04 RE-REVIEW FEES:

- A. Should Architect perform re-review due to failure of the Work to comply with the claims of status of completion made by the Contractor:
1. Owner will deduct the amount of such compensation from the final payment to the Contractor, for re-review compensation to architect.

1.05 CONTRACTOR'S CLOSEOUT SUBMITTALS:

- A. Evidence of compliance with requirements of governing authorities:
1. Certificate of Occupancy.
 2. Certificate of Inspection.
 - a} Mechanical
 - b} Electrical
 3. Fire Sprinkler Certificate
 4. City County underground approvals for all plumbing and electrical lines.
- B. List of all subcontractors and suppliers organized by specification section.
- C. Project Record Documents: refer to Requirements of Section 01720.
- D. Operating and Maintenance Data, Instructions to Owner's Personnel: Refer to requirements of Section 01730.
- E. Warranties and Bonds: Refer to requirements of Section 01740.
- F. Keys and Keying Schedule: Refer to requirements of Finish Hardware section.
- G. Provide AIA Document G706A, Contractor's Affidavit of Release of Liens: Refer to requirements of General and Supplementary Conditions.
- H. MSDS- Material safety data sheets to be included in close out documents

- I. Provide AIA Document G707, Consent of Surety to Final Payment Form.
- J. Contractor's asbestos free affidavit: Refer to requirements of Section 01800.
- K. HVAC Test and Balance Report.
- L. Digital construction photographs organized by date.
- M. HCISD PROJECT CLOSE-OUT CHECK LIST (attached herein) – Checked and verified by The Owner)**

1.06 FINAL ADJUSTMENTS OF ACCOUNTS:

- A. Submit a final statement of accounting to Architect. Statement shall reflect all adjustments to the Contract sum:
 - 1. The original Contract sum.
 - 2. Additions and deductions resulting from:
 - a} Previous change orders.
 - b} Allowances.
 - c} Unit Prices.
 - d} Deductions for uncorrected work.
 - e} Deductions for re-review payments.
 - f} Other adjustments.
 - 3. Total Contract sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- B. Architect will prepare a final Change Order, reflecting approved adjustments to the Contract sum, which were not previously made by Change Orders.

1.07 FINAL APPLICATION FOR PAYMENT:

- A. Contractor shall submit the final Application for Payment, labeled as Final, and in accordance with procedures and requirements stated in the Conditions of the Contract.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1: GENERAL:

1.01 GENERAL:

- A. Maintain at the site for the Owner one record copy of:
 - 1. Drawings
 - 2. Specifications
 - 3. Addenda
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Architect/Engineer Field Orders or written instructions.
 - 6. Approved Shop Drawings, Product Data and Samples.
 - 7. Field Test records.
 - 8. Construction photographs.
 - 9. Meeting Reports.
- B. The Contractor shall use one set of Construction Drawings provided to the Contractor at the time construction is commenced. These Drawings shall be marked-up by each Contractor, throughout the construction period, indicating all changes, revisions and additions to the Work, including field relocations of work concealed from view.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES:

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinets or secure storage space for storage of samples.
- B. File documents and samples in accordance with Data Filing Format of the Uniform Construction Index.
- C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
- D. Make documents and samples available at all times for view by Architect.

1.03 RECORDING:

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- C. Drawings: Legibly mark to record actual construction:
 - 1. Depths of various elements of foundation in relation to finish first floor datum.
 - 2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - 4. Field changes of dimension and detail.

SECTION 01720
PROJECT RECORD DOCUMENTS

5. Changes made by Field Order, Architectural Supplemental Instructions, Request for Information, Addenda, Construction Change Directive or by Change Order.
6. Details not on original Contract Drawings.

D. Specifications and Addenda: Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and supplier of each Product and item of equipment actually installed.
2. Changes made by Field Order, Architectural Supplemental Instructions, Request for Information, Addenda, Construction Change Directive or by Change Order.

1.04 SUBMITTAL:

- A. At the completion of work, Contractor shall certify, by endorsement thereof, that each of the revised drawings is complete and accurate. Prior to Contractor's application for final payment, and within forty-five {45} days of final acceptance of all the work by the Owner, unless otherwise modified by the Contract Agreement, and as a condition of acceptance by the Owner, Contractor shall deliver the certified Record Documents to the Architect for transmittal to the Owner.

END OF SECTION

SECTION 01730

OPERATING AND MAINTENANCE DATA

PART 1: GENERAL:

1.01 INFORMATION DATA:

- A. Compile Manufacturer's Directions and Manuals, Product Data and related information appropriate for Owner's maintenance and operation of product furnished under the Contract.
 - 1. Furnish operating and maintenance data as specified in other pertinent sections of Specifications.
- B. Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.

1.02 FORM OF SUBMITTALS:

- A. Prepare data in the form of an instructional manual for use by Owner's personnel.
- B. Provide indexed tabs fly-leaf for each separate product, or each piece of operating equipment. Provide typed description of product and major component parts of equipment.
- C. Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".
- D. Bind in commercial quality three-ring binders with durable and cleanable plastic covers.
- E. When multiple binders are used, correlate the data into related consistent groupings.

1.03 CONTENT OF MANUAL:

- A. Neatly typewritten table of contents for each volume, arranged in a systematic order.
 - 1. Contractor, name of responsible principal, address and telephone number.
 - 2. A list of each product required to be included, indexed to the content of the volume.
 - 3. List with each product, the name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance contractor, as appropriate.
 - c. Identify the area of responsibility of each.
 - d. Local source of supply for parts and replacement.
 - 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
- B. Product Data: Include only those sheets which are pertinent to the specific product. Annotate each sheet to:
 - 1. Clearly identify the specific product or part installed.
 - 2. Clearly identify the data applicable to the installation.
 - 3. Delete references to inapplicable information.
- C. Drawings: Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems, and control and flow diagrams.
 - 1. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - 2. Do not use Project Record Documents as maintenance drawings.

- D. Written text, as required to supplement product data for the particular installation:
 - 1. Organize in a consistent format under separate headings for different procedures.
 - 2. Provide a logical sequence of instructions for each procedure.
- E. Copy of each warranty, bond and service contract issued. Provide information sheet for Owner's personnel, give:
 - 1. Proper procedures in the event of failure.
 - 2. Instance which might affect the validity of warranties or bonds.

1.04 MANUAL FOR MATERIALS AND FINISHES:

- A. Submit in electronic file complete manual in final form and document in respective division.
- B. Content, for architectural products, applied materials and finishes:
 - 1. Manufacturer's data, giving full information on products.
 - 2. Instructions for care and maintenance.
- C. Content, for moisture-protection and weather-exposed products:
 - 1. Manufacturer's data, giving full information on products.
- D. Additional requirements for Maintenance Data: the respective sections of Specifications.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS:

- A. Submit in electronic file complete manual in final form and document in respective division.
- B. Content, for each unit of equipment and system, as appropriate:
 - 1. Description of unit and component parts.
 - 2. Operating procedures.
 - 3. Maintenance procedures.
 - 4. Servicing and lubrication schedule.
 - 5. Manufacturer's printed operating and maintenance instructions.
 - 6. Description of sequence of operation by control manufacturer.
 - 7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 8. As-installed control diagrams by controls manufacturer.
 - 9. Each contractor's coordination drawings.
 - 10. Charts of valve tag numbers, with the location and function of each valve.
 - 11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 - 12. Other data as required under pertinent sections of specifications.
- C. Content, for each electric and electronic system, as appropriate:
 - 1. Description of system and component parts.
 - 2. Circuit directories of panelboards.
 - 3. As-installed color coded wiring diagrams.
 - 4. Operating procedures.
 - 5. Maintenance procedures.

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OPERATING AND MAINTENANCE DATA

6. Manufacturer's printed operating and maintenance instructions.
 7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 8. Other data as required under pertinent sections of specifications.
- D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
- E. Additional requirements for Operating and Maintenance Data: the respective sections of specifications.

1.06 INSTRUCTIONS OF OWNER'S PERSONNEL:

- A. Prior to final review or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems.
- B. Operating and maintenance manual shall constitute the basis of instruction.
- C. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

END OF SECTION

SECTION 01740

WARRANTIES AND BONDS

PART 1: GENERAL:

1.01 SUBMITTAL REQUIREMENTS:

- A. Assemble warranties, bonds and services and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Review submittals to verify compliance with Contract Documents. Submit to Architect for review and transmittal to Owner.

1.02 TIME OF SUBMITTALS:

- A. For equipment or component parts of equipment put into service during progress of construction submit within ten {10} days after review and acceptance.
- B. Otherwise make submittals within ten {10} days after Date of Substantial Completion, prior to final request for payment.
- C. For items of work, where acceptance is delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten {10} days after acceptance, listing the date of acceptance as the start of the warranty period.

END OF SECTION

SECTION 01800

GENERAL NOTES

PART 1: GENERAL:

1.01 GENERAL NOTES:

- A. Contractor shall protect all streets and sidewalks and shall make all necessary repairs at his own expense.
- B. Shall at all times protect the excavations, trenches, and/or the building from damage from rain water, ground water, backing up drains or sewers and all other water. He shall provide all pumps and equipment and enclosures to provide this protection.
- C. Contractor shall provide all shoring, bracing and sheathing as required for safety and proper execution of the work and remove same when work is completed. Contractor shall be responsible for all scaffolding, shoring, bracing, sheathing, temporary construction and temporary walkways, etc., and shall hold harmless the Owner and Architect from any injury or litigation as a result of causes related to any scaffolding, shoring, bracing, sheathing, temporary construction, temporary walkways, and similar construction techniques.
- D. Contractor shall comply with the Trench Safety Law Requirements.

2.01 WAIVER OF LIEN:

- A. In submitting a Proposal (Bid) Contractor, if awarded the Contract, explicitly warrants that the Owner shall be held free of any claim or lien of any nature resulting from Contractor's pursuance or prosecution of the work. This shall cover any third party lien in any manner whatsoever concerning Contractor's performance or payment on this project.

3.01 PREVAILING WAGES:

- A. *Article 5159a, Vernon's Annotated Texas Civil Statutes as below noted apply to this project.*

"Not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed, and not less than the general per diem wages for legal holiday and overtime work, shall be paid to all laborers, workmen and mechanics employed by or on behalf of the State of Texas, or by or on behalf of any county, district or other political subdivision of the State, engaged in the construction of public works, exclusive of maintenance work".

- B. As provided in Section 00850.

4.01 CONTRACTOR'S ASBESTOS FREE AFFIDAVIT:

- A. In order to protect staff, employees and public in general from any unnecessary exposure to asbestos fibers, the Asbestos Hazard Emergency Response Act prohibits the use of asbestos containing materials in all forms in the construction and operation of this facility.
- B. Failure to complete this waiver constitutes non-compliance with the job specifications. This document shall be attached to the Contract between Owner and Contractor.

4.02 AFFIDAVIT:

- A. I certify that I am familiar with the materials used in the construction of, and incorporated into, the construction described below. I further certify that to the best of my knowledge and belief no asbestos containing materials,

SECTION 01800
GENERAL NOTES

either friable or otherwise were used in the process of constructing or incorporated into the construction.

- B. The undersigned, being duly sworn upon his/her oath deposes and says that he/she is the person making the foregoing statements and that they are made in good faith and are true in every respect.

Contractor's signature:

STATE OF

COUNTY OF

I, _____, a Notary Public in and for said County, in the State aforesaid, DO THEREBY CERTIFY THAT _____ personally known to me to be the same person whose name is subscribed to the foregoing instrument, appeared before me this day in person, and acknowledged that he/she signed, sealed, and delivered said instrument as his/her free and voluntary act, for the uses and purposes herein set forth.

GIVEN UNDER MY HAND AND NOTARIAL SEAL THIS _____ DATE OF _____, 20 .

NOTARY PUBLIC: _____

MY COMMISSION EXPIRES: _____

(NOTARY SEAL)

END OF SECTION

GENERAL DECISION: TX20100006 03/12/2010 TX6

Date: March 12, 2010

General Decision Number: TX20100006 03/12/2010

Superseded General Decision Number: TX20080006

State: Texas

Construction Types: Building and Residential

Counties: Cameron and Hidalgo Counties in Texas.

BUILDING AND RESIDENTIAL CONSTRUCTION PROJECTS (including single family homes and garden apartments up to and including 4 stories).

Modification Number	Publication Date
0	03/12/2010

* SUTX1990-013 05/01/1990

	Rates	Fringes
BOILERMAKER		
RESIDENTIAL CONSTRUCTION ONLY.....	\$ 16.35	2.315
BRICKLAYER		
RESIDENTIAL CONSTRUCTION ONLY.....	\$ 7.25	
CARPENTER (Including Drywall Hanging and Acoustical Ceiling Installation)		
BUILDING CONSTRUCTION ONLY Excluding Batt Insulation..	\$ 7.25	
CARPENTER		
RESIDENTIAL CONSTRUCTION ONLY.....	\$ 7.25	
CEMENT MASON/CONCRETE FINISHER (Excluding Form Setting)		
BUILDING CONSTRUCTION ONLY..	\$ 7.25	
CEMENT MASON/CONCRETE FINISHER		
RESIDENTIAL CONSTRUCTION ONLY.....	\$ 7.25	
ELECTRICIAN		
BUILDING CONSTRUCTION ONLY..	\$ 8.30	
Electricians: (Residential)		
RESIDENTIAL CONSTRUCTION ONLY.....	\$ 7.25	
FLOOR LAYER: CARPET (SOFT)		

FLOOR		
BUILDING CONSTRUCTION ONLY..\$	7.25	
RESIDENTIAL CONSTRUCTION ONLY.....\$	7.25	
Insulation Installer		
RESIDENTIAL CONSTRUCTION ONLY.....\$	7.25	
IRONWORKER, REINFORCING		
RESIDENTIAL CONSTRUCTION ONLY.....\$	7.25	
Laborer, common		
BUILDING CONSTRUCTION ONLY..\$	7.25	
LABORER		
RESIDENTIAL CONSTRUCTION ONLY		
Pipelayer.....\$	7.25	
Unskilled.....\$	7.25	
PAINTER (Including Drywall Finishing, Taping, and Bedding)		
BUILDING CONSTRUCTION ONLY..\$	7.25	
PAINTER		
RESIDENTIAL CONSTRUCTION ONLY.....\$	7.25	
PIPEFITTER (Including HVAC Work)		
BUILDING CONSTRUCTION ONLY..\$	7.28	.12
Plasterer tender		
BUILDING CONSTRUCTION ONLY..\$	7.25	
PLASTERER		
BUILDING CONSTRUCTION ONLY..\$	8.41	
RESIDENTIAL CONSTRUCTION ONLY.....\$	7.25	
PLUMBER (Excluding HVAC Work)		
BUILDING CONSTRUCTION ONLY..\$	7.50	.48
Plumbers and Pipefitters		
RESIDENTIAL CONSTRUCTION ONLY.....\$	8.20	
Power equipment operators:		
BUILDING CONSTRUCTION ONLY		
Backhoe.....\$	7.25	.48
RESIDENTIAL CONSTRUCTION ONLY		
Backhoe.....\$	7.25	
Grader.....\$	7.25	
Loader.....\$	7.25	
ROOFER, Including Built Up,		

Composition and Single Ply
Roofs

RESIDENTIAL CONSTRUCTION
ONLY.....\$ 7.25

Sheet metal worker

RESIDENTIAL CONSTRUCTION
ONLY.....\$ 7.25

Sheet Rock Installer

RESIDENTIAL CONSTRUCTION
ONLY.....\$ 7.25

SHEETMETAL WORKER (Including
HVAC duct Work)

BUILDING CONSTRUCTION ONLY..\$ 7.25

TILE SETTER

BUILDING CONSTRUCTION ONLY..\$ 7.25
RESIDENTIAL CONSTRUCTION
ONLY.....\$ 7.25

TRUCK DRIVER

BUILDING CONSTRUCTION ONLY..\$ 7.25
RESIDENTIAL CONSTRUCTION
ONLY.....\$ 7.25

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

Unlisted classifications needed for work not included within
the scope of the classifications listed may be added after
award only as provided in the labor standards contract clauses
(29CFR 5.5 (a) (1) (ii)).

In the listing above, the "SU" designation means that rates
listed under the identifier do not reflect collectively
bargained wage and fringe benefit rates. Other designations
indicate unions whose rates have been determined to be
prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can
be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on
a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests
for summaries of surveys, should be with the Wage and Hour

Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

SECTION 02050

DEMOLITION

PART 1: GENERAL

1.01 SUMMARY:

- A. Section Includes:
1. Demolition shall include, unless otherwise noted on Drawing, removal of existing objects of improvements, whether indicated on Drawings or not, that would, in the opinion of the Owner, prevent or interfere with progress or completion of proposed work.
 2. Permits, fees, and licenses shall be secured and paid for by Contractor, including disposal charges as required to ensure progress of work will proceed.
 3. Work shall comply with requirements of governing authorities in demolition of ***existing pavement, curbs and gutters, drainage structures, and utilities*** as may required.
 4. Demolition requires removal and disposal off site of following:
 - A} ***Building structures indicated of Drawings or as required by specifications.***
 - B} ***Building foundations and supporting walls to uniform depth of 12" below lowest foundation elevation.***
 - C} ***Building materials as indicated on drawings.***

1.02 RELATED REQUIREMENTS:

- A. Demolition drawings.

1.03 JOB CONDITIONS:

- A. Conditions existing at time of inspection will be maintained by Owner in so far as practicable. Variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. Owner shall indicate at pre-proposal conference those material decided to be salvaged for future use by Owner.
- B. Items of salvageable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed. Storage or sale of removed items on site will not be permitted.
- C. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility or injury to persons or for damage to property due to blasting operations. The performance of any required blasting shall comply with governing regulations.

1.04 PROTECTION:

- A. SUMMARY:
1. Ensure safe passage of persons around all areas of demolition.
 2. Conduct operations to prevent damage to adjacent buildings, structures, other facilities, or injury to persons.
 3. Promptly repair any damages caused to adjacent facilities by demolition operations at no cost to Owner.
 4. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
 5. Prevent interruption of existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction.
 6. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.
 7. Make arrangements, before initiating demolition, for relocating, disconnection, rerouting, abandoning, or similar action as may be required relative to utilities and other underground piping, to permit work to proceed without delay. Arrangements shall be made in accordance with regulations of authorities of utilities concerned, including but not restricting any other services not mentioned, such as overhead and underground power and telephone power lines and equipment, gas piping, storm sewers, sanitary

- sewers, or water piping. Contractor shall not use water when it may create hazardous or objectionable conditions, such as ice, flooding, or/or pollution.
8. Use water sprinkling and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level.
 9. Comply with governing regulations pertaining to environmental protection.
 10. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

PART 2: PRODUCTS:

- A. This part not used.

PART 3: EXECUTION:

3.01 BUILDING DEMOLITION:

- A. Demolish buildings completely and remove from site using methods as required to complete work within limitations of governing regulations.
- B. Proceed with demolition in systematic manner, from top of structure to ground and complete demolition work above each floor or tier before disturbing supporting members on lower levels.
- C. Locate demolition equipment and remove materials so as to prevent excessive loading to supporting walls, floors, or framing.
- D. Remove structural framing members and lower to ground by hoists, derricks, or other suitable methods.
- E. Demolish concrete and masonry in small sections. Break up and remove concrete slabs-on-grade unless otherwise shown to remain.
- F. Demolish and remove below grade construction and concrete slabs on grade to a minimum depth of twelve inches below lowest foundation elevations.

3.02 FILLING BASEMENTS AND VOIDS:

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures (tanks, wells, cisterns, etc.) using approved select fill materials free from debris, trash, roots, and other organic matter.
- B. Ensure that areas to be filled are free of standing water, trash, and debris prior to fill placement.
- C. Place fill materials in horizontal layers not exceeding eight inches (8") in loose depth and compact each layer at optimum moisture content of fill material to density equal to original adjacent ground, unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow to surface drainage structures after fill placement and compaction.

3.03 DISPOSAL OF DEMOLISHED MATERIALS:

- A. Remove from site, debris, rubbish, and other materials resulting from demolition operations.
- B. No burning of any materials, debris, or trash on-site or off-site will be allowed, except when allowed by the appropriate governing authority. If allowed as stated above, burning shall be performed in manner prescribed by governing authority.
- C. Transport materials removed from demolished structures and dispose off-site to areas which are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION

SECTION 02281

TERMITE CONTROL

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete the Termite Protection indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division 0 - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual apply to all work required for this section.

1.02 GENERAL REQUIREMENTS:

- A. Chemical soil treatment specified herein shall be applied to all soil below all buildings with slab on grade floors to be constructed under this Contract.
- B. Treatment shall be performed by an experienced pest control operator in a timely fashion and in a manner that will produce the specified results. Pest control operator shall be registered and licensed in accordance with the regulations of the State and governed by local Pest Control Boards.
- C. Safety precautions recommended by the Forest Service in U. S. Department of Agriculture Forest Pest Leaflet #68 beginning "Pesticides used improperly can be injurious to man, animals and plants...." shall be complied with during time of the soil treatment.

1.03 GUARANTEE - WARRANTY BOND:

- A. Furnish written guarantee and warranty providing that the soil has been treated and that the chemical used in the treatment, its concentration, rate, method and location complies in every respect with these specifications.
- B. If subterranean termite infestation should occur in the treated buildings within a period of one (1) year from date of acceptance by the Owner, the Contractor promptly, and without cost to the Owner, shall:
 - 1) Re-treat the soil in substantial conformance with these specifications; and
 - 2) Repair all construction damage caused by subterranean termites within the warranty period.
- C. If, during the term of the guarantee, any additions or alterations are made which affect the structure and create new termite hazards, or interfere with the chemical protective barrier, the guarantee becomes null and void unless treatment is applied to additions or alterations as specified herein.
- D. The guarantee-warranty shall be effectuated by a bond issued by a surety company licensed in the State where the Project is located and the penal sum be not less than \$5,000.00.
- E. After the elapse of the above warranty-bond, the coverage of \$5,000.00 termite protection may be continued by payment of a specified annual premium which includes a re-treatment and re-inspection on an annual basis to prevent termite infestation of the project.

PART 2: PRODUCTS:

2.01 MATERIALS:

- A. Materials shall be formulated as an emulsible concentrate for subsequent dilution with water. Fuel Oil will not be permitted due to its susceptibility to capillary absorption by concrete and its ability to damage adhesives,

SECTION 02281
TERMITE CONTROL

floor materials and water membranes.

- B. Chemical and Concentrations: Apply to soil areas to be treated, one of the following chemicals at not less than the designated concentration:
CHEMICALS: DURSBAN TC or other EPA approved and labeled chemical for use in termite control in concentration as recommended by manufacturer.
- C. Working solution shall be prepared by diluting the chemical with water as recommended and stored, handled and applied in accordance with the directions on the manufacturer's label.
- D. In some cases soil will not accept liquids at the reference rates of applications. When the condition exists, a lesser volume of carrier, with an equivalently greater concentration of toxicant may be used.
- E. If the EPA ban on Chlordane is removed prior to scheduled application, Contractor shall use Chlordane 1.0%-2.0% applied in water solution. If EPA ban is not removed, DO NOT USE CHLORDANE.
- F. If EPA ban is removed prior to bid time, bid Chlordane. If EPA ban is removed between bid time and application time credit Contract cost difference between chemical bid and Chlordane.

PART 3: EXECUTION:

3.01 APPLICATION:

- A. Apply working solution after subgrade has been made ready for placement of any floor vapor barrier and as soon as practical prior to placement of any concrete slabs. Footings, foundations, masonry piers, and other foundation work including sub-soil drainage shall have been completed.
- B. Do not apply working solution when soil and fill are excessively wet. Backfilling shall have been completed prior to treatment. Treated areas shall not be disturbed during subsequent construction operations.
- C. Apply working solution uniformly to all on-grade and below-grade ground areas to be covered by concrete floor slab, including entries, etc., which about principal building slabs, at the rate recommended by manufacturer.
- D. Apply working solution uniformly along entire inside and outside perimeters of foundation walls, and around piers, footings, sewer pipes, conduits, interior walls, etc. Saturate not less than 1 foot in depth and 2 feet around each pipe or conduit penetration.
- E. Materials and application shall conform to "Approved Reference Procedure" of the National Pest Control Association.

END OF SECTION

SECTION 02831

CHAIN LINK FENCES AND GATES

PART I GENERAL

1.01 SECTION INCLUDES

Provide chain link fences and gates units controlled by single source including erection accessories, fittings, and fastenings as indicated on Drawings. Refer to architectural building plans for fencing attached to building.

1.02 RELATED SECTIONS

- A. Construction Drawings
- B. Manufacturer's technical data and installation requirements

1.03 REFERENCES

- A. ANSI/ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- B. ANSI/ASTM F567 - Installation of Chain-Link Fence.
- C. ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
- D. ASTM A120 - Pipe, Steel, Black and Hot-Dipped zinc Coated (Galvanized) welded and seamless, for Ordinary Uses.
- E. ASTM A121 - Zinc-Coated (Galvanized) Steel Barbed Wire.
- F. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- H. ASTM A428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- I. ASTM A491 - Aluminum-Coated Steel Chain Link Fence Fabric.
- J. ASTM A569 - Steel, Carbon (0.15 Maximum Percent), Hot- Rolled Sheet and Strip Commercial Quality.
- K. ASTM A585 - Aluminum Coated Steel Barbed Wire.
- L. ASTM C94 - Ready-mixed Concrete.
- M. ASTM F573 - Residential Zinc-Coated Steel Chain Link Fence Fabric.
- N. ASTM F668 - Polyvinyl Chloride (PVC) Coated Steel Chain Link Fence Fabric.
- O. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.
- P. FS RR-F-191 - Fencing, Wire and Post Metal (and Gates, Chain Link Fence Fabric, and Accessories).

1.04 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of property perimeter posts relative to property lines and easements.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:

1. Allied Tube and Conduit Corp.
2. Anchor Fence, Inc.
3. United States Steel

2.02 MATERIALS

- A. Fabric:

1. No. 9 ga. (0.148" \pm 0.005") finished size galvanized steel wires, 2" mesh, with both top and bottom selvages twisted and barbed.
2. Furnish one-piece fabric widths for fencing.

- B. End, Corner, and Pull Posts: Galvanized steel, minimum sizes and weights as follows:

1. 4.85 lbs./lin. ft.
2. Over 6'-0" Fabric Height: 2.875" OD pipe, 5.79 lbs./lin. ft., or 3.5"x3.5" roll-formed sections, 4.85 lbs./lin. ft.

- C. Line Posts: Galvanized steel, minimum sizes and weights as follows:

1. Up to 6'-0" Fabric Height: 1.90" OD steel pipe, 2.70 lbs./lin. ft. or 1.875"x 1.625" C-sections, 2.28 lbs./lin. ft.
2. 6'-0" to 8'-0" Fabric Height: 2.375" OD steel pipe, 3.65 lbs./lin. ft. or 2.25"x 1.875" H-sections, 2.64 lbs./lin. ft.
3. Over 8'-0" Fabric Height: 2.875" OD steel pipe, 5.79 lbs./lin. ft. or 2.25"x 1.875" H-sections, 3.26 lbs./lin. ft.

- D. Gate Posts: Galvanized steel, posts for supporting single gate leaf, or one leaf of double gate installation, for nominal gate widths as follows:

1. Up to 6' -0": 3.5" x 3.5" roll-formed section, 4.85 lbs./lin. ft., or 2.875 OD pipe, 5.79 lbs./lin. ft.
2. Over 6' -0" to 13' -0": 4.000", OD pipe, 9.11 lbs./lin. ft.

- E. Top Rail: Rails: 1.66", OD pipe, 2.27 lbs./ft. or 1.625"x 1.25", roll-formed sections, 1.35 lbs./ft.; galvanized steel, manufacturer's longest lengths.

- F. Couplings: Expansion type, approximately 6" long, for each joint.
- G. Attaching Devices: Provide means for attaching top rail securely to each gate corner, pull and end post.
- H. Sleeves: Galvanized steel pipe not less than 6" long and with inside diameter not less than ½" greater than outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve of width and length not less than 1" greater than outside diameter of sleeve.
- I. Tension Wire: 7 gage galvanized steel, coated coil spring wire, located at bottom of fabric.
- J. Wire Ties: 11 ga. galvanized steel
- K. Post Brace Assembly: Manufacturer's standard adjustable brace at end of 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.
- L. Post Tops: Galvanized steel, weathertight closure cap for each tubular post. Furnish caps with openings to permit passage of top rail.
- M. Stretcher Bars: Galvanized steel, one piece lengths equal to full height of fabric, with minimum cross-section of 3/16" x ¾". Provide one stretch bar for each gate and end post, and two for each corner and pull post.
- N. Stretch Bar Bands: Manufacturer's standard.
- O. Gate Cross-bracing: 3/80 diameter galvanized steel adjustable length truss rods.
- P. Portland Cement: ASTM C 150.
- Q. Aggregates: ASTM C 33.
- R. Water: Clean.
- S. Non-shrink, non-Metallic Grout: Premixed, factory- packaged, noncorrosive nonstaining, nongaseous, exterior grout complying with CE CRD-C621.
- T. Swinging Gate Hardware:
1. Hinges: Size and material to suit gate size, non- lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2" pair of hinges for each leaf over 6"-0" nominal height.
 2. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- U. Double Gates Hardware: Provide gate stops for double gates, consisting of mushroom type of flush plate with anchors set in concrete, to engage center drop rod or plunger bar. Include locking device and padlock eye as integral part of latch, using one padlock for locking both gate leaves.

- V. Sliding Gate Hardware: Provide manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.

PART 3 EXECUTION

3.01 GATE FABRICATION

- A. Fabricate swing gate perimeter frames of 1.90" OD pipe, galvanized steel. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories. Space frame members maximum of 8'-0", apart.
- B. Assemble gate frames by welding or special fittings and rivets, for rigid connections. Install same fabric as for fence with stretcher bars at vertical edges. Install diagonal cross-bracing on gates as required to ensure rigid frame without sag or twist. Bars may be used at top and bottom edges. Attach stretchers to gate frame at 15" o.c. maximum.
- C. Attach hardware to provide security against removal or breakage.

3.02 FINISH

- A. Fabric Finish: Galvanized, ASTM A 392, Class I, with not less than 1.2 oz. zinc/sq. ft. of surface.
- B. Framing: Galvanized steel, ASTM A 120 or A 123, with not less than 1.8 oz. zinc/sq. ft. of surface.
- C. Hardware and Accessories: Galvanized, ASTM A 153 with zinc weights in accordance with Table I.

3.03 CONCRETE MIXING

Mix materials to obtain concrete with minimum 28-day compressive strength of 2,500 psi; in maximum size aggregate, maximum 3" slump, and 2-4% entrained air.

3.04 INSTALLATION

- A. Comply with recommended procedures and instructions of fencing manufacturer. Provide secure, aligned installation with line posts spaced at 10'-0" o.c. maximum.
- B. Grade Set Posts: Drill or hand excavate using post hole digger in firm undisturbed or compacted soil.
- C. Excavate hole for each post to minimum diameter recommended by fence manufacturer but not less than four times the largest cross-section of post. Excavate hole depths not less than 36" below finish grade surface.
- D. Center and align posts in holes with bottom of posts 3" above bottom of excavation.
- E. 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. Extend concrete footing 2" above grade and trowel to crown to shed water.

- F. Sleeve Set Posts: Anchor posts by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with nonshrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.
- G. Top Rails: Run rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- H. Center Rails: Provide center rails where indicated. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- I. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- J. Tension wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 ga. galvanized steel hog rings spaced 24" o.c.
- K. Fabric: Leave approximately 2" between finish grade and bottom selvage. 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.
- L. Stretcher Bars: Secure at end, corner, pull, and gate posts by threading through or clamping to fabric at 4" o.c., and secure to posts with metal bands spaced at 15" o.c.
- M. Tie Wires:
1. Use U-shaped wire, conforming with diameter of pipe to which attached, clasping pipe and fabric firmly when ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
 2. Tie fabric to line posts with wire ties spaced 12" o.c. Tie fabric to rails and braces with wire ties spaced 24" o.c. Tie fabric to tension wires with hog rings spaced 24" o.c.
 3. Manufacturer's standard procedure will be accepted if of equal strength and durability.
- N. 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.
- P. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubrication.

END OF SECTION 02831

SECTION 01025 SPECIAL PROVISIONS

IN ALL CASES WHERE THESE SPECIAL PROVISIONS CONFLICT WITH THE TECHNICAL SPECIFICATION SECTIONS OR ANY OTHER DOCUMENT CONTAINED HEREIN, THESE SPECIAL PROVISIONS SHALL GOVERN.

1. The CONTRACTOR shall do all necessary excavation, trenching, demolition, grading, backfill, etc., to complete the project. All excavation is unclassified. All material removed such as concrete, broken pipe, excess backfill, etc., shall become the property of the CONTRACTOR and he shall be responsible for removing it from the site at not extra expense to the OWNER. Existing material, fencing or fixtures deemed salvageable by the ENGINEER or the OWNER shall be carefully removed and hauled to a designated location as directed by the OWNER or ENGINEER at no extra expense to the OWNER.
2. All trees, plants, grass and shrubs, except those which will be affected by construction shall be protected at all times. The areas in and adjacent to the construction site shall be restored to their original conditions after necessary fine grading is completed. The CONTRACTOR shall provide new grass of the same type removed to restore damaged areas. Only quality sandy loam topsoil shall be used for filling the top four inches of those areas damaged or filled.
3. Damages done to existing utilities, power poles, fences, signs, mailboxes, driveways, culverts, pavement, drainage systems, etc. shall be repaired by the CONTRACTOR at no cost to the OWNER, and such costs shall be subsidiary to the various unit items in the Proposal.
4. Existing lawns are to remain intact as far as practical. The CONTRACTOR shall duly restore such areas disturbed as good as or better than original condition using the same type of grass, shrubs, or cover as the original. The CONTRACTOR shall be responsible for correcting any erosion that occurs at his cost without claim for extra compensation.
5. The CONTRACTOR shall be limited only to existing property for operations and/or easements provided by the Owner. The CONTRACTOR at no extra cost to the OWNER will correct any damages done to property outside these designated work areas to its original or better conditions. It is important that the CONTRACTOR be aware of the work limits so that no damage can result to those areas outside these limits.

6. The CONTRACTOR shall submit to the ENGINEER a proposed sequence of work outline with approximate completion dates to be reviewed at the pre-construction conference. It is important that traffic be interrupted at a minimum during construction. If roadways are to be closed or detoured, the CONTRACTOR shall notify the POLICE DEPARTMENT, FIRE DEPARTMENT, EMERGENCY SERVICES, and other interested entities at least 48 hours in advance.
7. The CONTRACTOR shall be responsible for construction staking for the entire project and shall be done in accordance with the Specifications. The OWNER shall provide horizontal and vertical control.
8. The Plans show approximate locations of existing utilities including gas lines, telephone lines, power lines, water lines, sewer lines, storm sewers and irrigation lines within the vicinity. The CONTRACTOR is responsible for locating all existing utilities and shall exercise extreme care in working in the vicinity of these lines. All existing lines, whether belonging to **North Alamo Water Supply Corporation** or Private shall remain in operation at all times. Switchover time, re-connecting new service from existing lines or services (if any) shall be kept to a minimum. Contractor shall be responsible for any re-connects, temporary or otherwise, of all water and sanitary sewer lines required to complete the project. Unless otherwise specified, payment for such items shall be subsidiary to all the various items of the bid.
9. The Contractor shall notify the Utility Companies while working in the vicinity of the corresponding private or public utility.
10. The OWNER reserves the right to add or delete quantities of items in the Proposal at the Unit Prices given.
11. The CONTRACTOR is expected to conduct his work in such a manner as to minimize any soil erosion or sediment runoff from the construction site. Earth cuts and fills shall have smooth, flat side slopes, as generally indicated on the Plans, to preclude erosion of the soil. Such operations should be, at all times, consistent with the actual need for doing the work and only to leave raw, unprotected surfaces for a minimum of time.
12. Until acceptance by the ENGINEER of any part of all of the material, as provided for in these

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specifications, it shall be under the charge and care of the CONTRACTOR, and he shall take every necessary precaution against injury or damage to any part of the material by action of the elements or from the non-execution of the work. The CONTRACTOR shall rebuild, repair, restore and make good, at his own expense, all injuries or damage to any portion of the material occasioned by any of the above causes before its completion and acceptance.

13. In cases where the CONTRACTOR deems extra compensation is due him for materials not clearly covered in the contract, or not ordered by the ENGINEER as an extra item, the CONTRACTOR shall notify the ENGINEER in writing of his intention to make claim for such extra compensation before he begins the work. The CONTRACTOR shall not proceed until the OWNER, ENGINEER, and CONTRACTOR approves a written CHANGE ORDER. Failure on the part of the CONTRACTOR to give such notification or to afford the ENGINEER proper facilities for keeping strict account of actual cost shall constitute a waiver of the claim for such extra compensation. The filing of such notice by the CONTRACTOR and the keeping of costs by the ENGINEER shall not in any way be construed to prove the validity of the claim. When the work has been completed, the CONTRACTOR shall, within 10 days, file his claim for extra compensation with the ENGINEER.
14. Upon the failure of the CONTRACTOR to repair satisfactorily or to remove and replace, if so directed, rejected, unauthorized, or condemned materials immediately after receiving formal notice from the ENGINEER, the OWNER may recover for such defective materials on the CONTRACTOR'S bond, or by action in a court having proper jurisdiction over such matters, or may employ labor and equipment and satisfactorily repair or remove and replace such work and charge the cost of the same to the CONTRACTOR, which cost will be deducted from any money due him.
15. Contractor is responsible for all traffic control. All proposed routing of traffic must be approved in writing prior to implementation. All traffic control devices shall be in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD), latest edition. Unless specifically indicated in the bid proposal form, cost shall be subsidiary to the various items of the bid.
16. Saw cutting of existing asphalt or concrete for construction joints will be the only accepted method.
17. Mechanical tamping of all backfilling shall be the only accepted method as shown in the typical

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trench backfill details of the plans.

18. The CONTRACTOR shall warrant all work for a period of not less than one (1) year from the date of final acceptance of the work by the Owner. CONTRACTOR is responsible for scheduling a final inspection in the presence of the OWNER, ENGINEER, and CONTRACTOR, whereupon all items must be in accordance with plans and specifications prior to final acceptance.
19. The CONTRACTOR is responsible for familiarizing himself and following all **North Alamo Water Supply Corporation and County of Hidalgo** Standard Specifications for those items not specifically shown on the project plans or project specifications.
20. All asphalt pavement repairs shall be completed as per the construction plans and specifications. The CONTRACTOR shall not leave an area requiring repairs in excess of 1,300 square yards or in excess of 30 days, whichever is less. Owner can require immediate asphalt pavement repair should traffic conditions warrant in the opinion of the Engineer or his agent.

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SECTION 02050 - DEMOLITION

PART 1 - EXECUTION

1.01 GENERAL REQUIREMENTS

A. 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 project. Rubbish and debris shall be removed from the project site daily. Materials that cannot be removed daily shall be stored in areas specified by the Owner.

1.02 DUST CONTROL

A. The amount of dust resulting from demolition shall be controlled to prevent the spread of dust 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.

1.03 PROTECTION

A. 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 of 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 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.

B. Protection of Buildings from the Weather

All materials and equipment shall be protected from the weather at all times.

C. Protection of Trees

Trees within the project site which might be damaged during demolition and which is indicated to be left in

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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 or 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.

1.04 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.05 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.06 EXISTING FACILITIES

A. Existing structures indicated shall be removed to grade.

B. Removal of Utilities

C. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings the Engineer shall be notified prior to removal.

1.07 DISPOSITION OF MATERIAL

A. Title to Materials

Title to all materials and equipment to be demolished 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.

B. Material for Contractor Salvage

Salvage materials shall be removed from project site before completion of the Contract. Material for salvage shall not be sold on the site.

END OF SECTION

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SECTION 02100 - SITE PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Demolition of existing site elements per Demolition Plan and/or as required for installation of new work.
- B. Clearing of site.

1.02 RELATED SECTIONS:

- A. Temporary erosion and sediment control during construction - Section 02150s.
- B. Earthwork - Section 02200 or Section 02202 and/or Section 02222

1.03 NOTIFICATION TO OWNERS OF UTILITY LINES AND EQUIPMENT:

- A. Notify any corporation, company, individual or local authority owning conduits, wires, pipes or equipment on site that is affected by work.
- B. Arrange for removal or relocation of indicated items and pay any fees or costs in conjunction with removal or relocation, except as otherwise noted.
- C. Cap lines in accordance with instructions of governing authorities or Owners.

1.04 PROTECTIONS:

- A. Protect trees, plants and other landscape features designated to remain.

1.05 EXPLOSIVES:

- A. Use of explosives is strictly prohibited.

PART 2 - PRODUCTS - NONE IN THIS SECTION

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Verify that abandoned utilities have been properly disconnected and capped.
- B. Verify that barricades and other protective measures are in place.

3.02 CLEARING:

- A. Remove existing scrub trees and shrubs, including root systems.

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- B. Strip and clear building areas, or areas requiring cutting or filling, free of vegetation. Leave construction areas clean, free of vegetation and debris, and ready for earthwork.
- C. Remove debris and trash from site.

END OF SECTION

SECTION 02102 - GENERAL CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. Cleaning and grubbing shall consist of the removal of trees, stumps, brush, roots, vegetation, logs, rubbish, and other objectionable matter within the project site limits described in the specifications or as shown on plans.
- B. Cleaning and grubbing shall be done in advance of grading operation. Grubbing may be done simultaneously with excavation, if the cuts are over 3 feet in depth and objectionable matter is removed as specified.
- C. Clearing and Grubbing shall consist of the disposal of all debris resulting from the work specified herein.

1.02 PROTECTION OF ADJACENT WORK:

- A. Provide protection necessary to prevent injury or damage to existing improvements, adjacent property, utilities and other facilities, and trees and plants, indicated to remain in place.
- B. Protect improvements on adjoining properties and all areas outside indicated construction areas from injury or damage.
- C. Restore damaged improvements to their original condition, as acceptable to the Engineer and property owners.
- D. Conduct site clearing and grubbing operations to ensure minimum interference with road, streets, walks, and other adjacent, occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide all required personnel, equipment, and materials required to perform the work as specified.

PART 3 - EXECUTION**3.01 CLEARING:**

- A. Clear all areas covered by dikes, roads, structures and embankments within project limits unless otherwise shown in plans.
- B. Remove all saplings, brush, down-timber and debris unless shown or directed otherwise.
- C. Use tree wound paint to treat scars, gashes or limbs stubs on trees not removed.

3.02 GRUBBING:

- A. Trees, stumps, root systems, rocks and other obstructions shall be removed to the depths shown when they fall within the construction templates for the following items:
 - 1. Footings 18-inches below bottom of footing.
 - 2. Sidewalks (or other types of walks) 12-inches below bottom of walk.
 - 3. Roadways or Streets 24-inches below bottom of base material.
 - 4. Parking Areas 24-inches below bottom of base material.
 - 5. Grassed Areas 18-inches below top soil.
 - 6. Fills 24-inches below bottom of fill.
- B. Blasting not permitted.

3.03 REMOVAL OF DEBRIS AND CLEANUP

- A. Burn as permitted by regulating agencies or the Engineer as work progresses.
- B. Unguarded fires will not be permitted.
- C. Permits will be obtained, where required, for necessary burning or disposal sites.

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- D. Dispose of all waste materials not burned by removal from site.
- E. Materials cleared and grubbed shall be the property of the Contractor and shall be his responsibility for disposal.

PART 4 - MEASUREMENT AND PAYMENT

4.01 CLEARING AND GRUBBING:

- A. Clearing and Grubbing shall be measured for payment either in acres or by lump sum only for areas indicated on the plans, or as provided in the proposal and contract.
- B. When not listed as separate contract pay item, Clearing and Grubbing shall be considered as incidental work, and the cost thereof shall be included in such contract pay items as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor equipment, tools and in incidentals required for the work, all in accordance with the plans and these specifications.

*** * * END OF SECTION * * ***

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SECTION 02110 - SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Extent of site clearing is shown on drawings.
- B. Site clearing work includes, but is not limited to:
 - 1. Protection of existing trees and shrubs.
 - 2. Removal of trees and other vegetation.
 - 3. Topsoil stripping and storing.
 - 4. Clearing and grubbing.
 - 5. Removing above grade improvements.
 - 6. Removing below grade improvements.

1.03 JOB CONDITIONS

- A. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition as acceptable to parties having jurisdiction.
- B. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

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1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
2. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations in a manner acceptable to Architect. Employ licensed arborist to repair damages to trees and shrubs.
3. Replace trees which cannot be repaired and restored to full growth status as determined by Arborist.

PART 2 - PRODUCTS (Not applicable to work of this section)

PART 3 - EXECUTION

3.01 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated. Removal includes digging out stumps and roots.
 1. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter and without weeds, roots, and other objectionable material.
 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 - a. Remove heavy growth of grass from areas before stripping.
 - b. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.
 2. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind blown dust.
 3. Dispose of unsuitable or excess topsoil same as waste material, herein specified.
- C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation except for those indicated to be left standing.
 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to be left standing.

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3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 4. Place fill material in horizontal layers not exceeding 6" loose depth and thoroughly compact to a density equal to adjacent original ground.
- D. Removal of Improvements: Remove existing above grade and below grade improvements necessary to permit construction and other work as indicated.
1. Abandonment or removal of certain underground pipe or conduits may be shown on mechanical or electrical drawings and is included under work of those sections. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

3.02 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Removal from Owner's Property: Remove waste materials and unsuitable and excess topsoil from Owner's property and dispose of off site in legal manner.

END OF SECTION

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SECTION 02150 - TEMPORARY EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Temporary measures required to control erosion and sediment during construction. This includes measures to meet the requirements of the National Pollution Discharge Elimination System (NPDES) administered by the Environmental Protection Agency (EPA).
- B. Temporary hay bale dike.
- C. Stabilized construction entrance.
- D. Silt fence.
- E. Rock check dam.
- F. Sediment basin with stone and pipe outlet
- G. Diversion dike.
- H. Storm Water Pollution Prevention Plan (SWP3).

1.02 RELATED SECTIONS:

- A. Grass seeding for slope protection and erosion control - Section 02270.
- B. Site Preparation - Section 02100.
- C. Earthwork - Section 02200 or Section 02202 and/or 02222

1.03 REFERENCES:

- A. ASTM D3786 - Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics. (Mullen Burst)
- B. ASTM D3787 - Bursting Strength of Knitted Goods; Constant Rate of Traverse (CRT) Ball Burst Test

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- C. ASTM D4355 - Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
- D. ASTM D4491 - Water Permeability of Geotextiles by Permittivity.
- E. ASTM D4533 - Index Trapezoidal Tearing Strength of Geotextiles.
- F. ASTM D4632 - Grab Breaking Load and Elongation of Geotextiles. (Tensile Strength).
- F. ASTM D4751 - Determining the Apparent Opening Size of a Geotextile.
- H. ASTM A116, - Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric.
- I. ASTM D698 - Test for Moisture Density Relations for Soils (Standard).
- J. Texas Department of Transportation (TXDOT) 2004 Standard Specifications for Construction of Highways, Streets and Bridges. Measurement and payment sections do not apply. Item 432 - Rip Rap.

1.04 SUBMITTALS:

- A. Procedures for Submittals: Section 01300.
- B. Product Data:
 - 1. Silt fencing.
 - 2. Non-woven filter fabric.
 - 3. Erosion control and revegetation mat
- C. Prepare and submit a Storm Water Pollution Prevention Plan (SWP3).
- D. Inspection Reports and Certificates:
 - 1. Submit period inspection reports and certificates required for SWP3.
 - 2. Submit Contractor/Subcontractor certifications required for SWP3.
- E. Submit revisions or modifications to the erosion and sediment control plan and SWP3.

1.05 MAINTENANCE:

- A. Maintain erosion control devices as necessary to comply with NPDES. This includes any revisions or modifications to the plan. Any work required for modifications, revisions and maintenance shall be the responsibility of the Contractor and shall not be a basis for additional compensation.

PART 2 - PRODUCTS**2.1 MATERIALS:**

- A. Hay bales, if used, shall weigh a minimum of (50) pounds and shall be at least thirty (30) inches in length. Bales shall be composed entirely of vegetable matter and be free of seeds. Binding shall be either wire or nylon string, jute or cotton binding is unacceptable. Bales shall be used for not more than two months before being replaced. However, if weather conditions cause biological degradation of the hay bales, they shall be replaced sooner than the two month time period to prevent a loss of structural integrity of the hay bale dike.
- B. Stone material at all drainage structures shall consist of stone rip-rap conforming to TXDOT Standard Specification Item 432 and shall have gradation and be placed as shown on the plans and in a layer of at least 24 inches thick. Stone material for rock check dams shall consist of only well graded crushed rock, 4-8 inches in diameter, and shall be placed as detailed on plans. Stone material for stabilized construction exit shall consist of 3" to 5" crushed rock mixed with Type "A" Flexbase to create a drivable surface and shall be placed as shown on the plans.
- C. Geotextile Fabrics shall be a non-woven polypropylene fabric designed specifically for use as a soil filtration media. Fabric shall have an approximate weight of 8 oz/sqyd.
- D. Geotextile Silt Fence Fabric shall be a nylon reinforced polypropylene woven fabric having a reinforcing cord running the entire length to the top edge of the fabric.

Representative Manufacturer Mirafi, Inc. silt fence, Amoco (2130) or owner approved equal.
- E. Fence Posts for Silt Fence of sufficient length and strength to support the silt fence system.

PART 3 - EXECUTION**3.01 EXAMINATION AND PREPARATION:**

- A. Submit SWP3 and the erosion and sediment control plan and modify as required for the Contractor's construction sequence. Modifications shall maintain conformance with the Contractor's storm water pollution prevention plan and the requirements of NPDES. Work and materials required for installation, modification and maintenance of the Erosion Control System shall be incidental to the contract.
- B. Locate and protect survey horizontal and vertical control.

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3.02 TEMPORARY HAY BALE DIKE:

- A. Install where shown on the plans or as needed for erosion control.
- B. Hay bales shall be embedded a minimum of four (4) inches and securely anchored using 3/8. inch diameter steel stakes or 2" x 2" wood stakes driven through the bales into the ground a minimum of six (6) inches. Hay bales are to be placed end to end directly adjacent to one another leaving no gap between them.
- C. Hay bale dikes are to be used in locations receiving overland sheet flow only.

3.03 STABILIZED CONSTRUCTION EXIT

- A. A temporary construction exit shall be installed at any point where traffic will be leaving the construction site to a public right-of-way, street, alley, sidewalk or parking area. The purpose of a stabilized construction exit is to reduce or eliminate the tracking or flowing of sediment onto public rights-of-way. The exit must be properly graded or incorporate a drainage swale to prevent runoff from leaving the construction site. The length of the exit shall be as required, but not less than 100 feet and the width shall be at least 20 feet. The stabilized exit shall be constructed of rock as described in 2.1.B. and shall be completely underlined with geotextile filter fabric described in 2.1.C, Value 1.
- B. The temporary construction exit shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or clean out of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately by the Contractor.
- C. When necessary, wheels must be washed or brushed to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse using approved methods.

3.04 SILT FENCE:

- A. Silt Fence: Shall consist of nylon reinforced polypropylene woven fabric supported by posts set a minimum depth of 18 inches and spaced not more than 6 feet on center. A 6-inch wide trench is to be cut 6 inches deep at the toe of the fence on the uphill side to allow the fabric to be laid below the surface and back filled with gravel. Fabric shall have a 6-inch, double overlap securely fastened at a post at abutting ends, and shall be joined such that no leakage or bypass occurs. Remove accumulated sediment when the depth of sediment reaches 6 inches.

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3.05 ROCK CHECK DAM:

- A. Rock Check Dams shall be constructed at locations shown on the plans and in swales as needed to reduce velocity in swales. Geotextile fabric as described in 2.1.C., Value I shall be placed beneath the rock and shall conform to these specifications. Rock shall conform to these specifications.

3.06 DIVERSION DIKE:

- A. Diversion dikes, if used by the Contractor, shall be installed prior to and maintained for the duration of construction and shall intercept no more than five (5) acres of runoff. Dikes shall have a minimum top width of 2'-0" and a minimum height Of Compacted fill of 18" measured from the top of the existing ground at the upslope toe to top of the dike and having side slopes of 3:1 or flatter. The channel which is formed by the dike must have a minimum slope of one (1) percent for the entire length to an outlet. When the slope exceeds three (3) percent, or velocities exceed one foot per second (regardless of slope), stone stabilization (Type "Am rip-rap) is required. Plant grass on dikes not requiring stone stabilization.

3.07 STORM WATER POLLUTION PREVENTION PLAN (SWP3):

- A. The Contractor is required to prepare the SWP3 required for this project.

3.08 NOTICE OF INTENT (NOI), NOTICE OF TERMINATION (NOT):

- A. Contractor shall submit a Notice of Intent (NOI) at least 48 hours prior to the start of construction.
- B. Contractor shall submit a Notice of Termination (NOT) as required by the NPDES regulations.

3.09 At the close of this contract the Contractor shall remove the temporary erosion control devices when permanent facilities are in place.

END OF SECTION

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SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Extent of earthwork as indicated on drawings, and includes:
 - 1. Preparation of subgrade for flatwork, pavements and all other earthwork installation.
 - 2. Removal and Replacement of Top Soil.
 - 3. This section “does not include” work beneath foundations or structural fill.
- D. Definitions:
 - “Excavation” consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
 - “Density” is referred to as a percentage of the ASTM D698. Standard Proctor Density

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Testing and Inspection Service: Employ, at Contractor’s expense, testing laboratory to perform soil testing and inspection service for quality control testing during earthwork operations. Laboratory to be approved by Architect and Owner.

1.04 SUBMITTALS

- A. Test Reports-Excavating: Submit following reports directly to Architect/Engineer from the testing services with a copy to the Contractor and Owner.
 - 1. Test reports on borrow material. (as required)
 - 2. Field density test reports.

3. One optimum moisture-maximum density curve for each type of soil encountered.
- B. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil bearings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.
1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- C. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Utility Owner.
 2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours except when permitted in writing by Architect and Owner and then only after acceptable temporary utility services have been provided.
 - a. Provide a minimum of forty eight (48) hour notice to Owner and receive written notice to proceed before interrupting any utility.
 3. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
- D. Use of Explosives: The use of explosives is not permitted.
- E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
1. Operate warning lights as recommended by authorities having jurisdiction.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
 3. Perform excavations within drip line of large trees to remain by hand and protect root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

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PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Definitions:

1. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.
2. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.
3. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock, or gravel larger than 2" in any dimension, debris, waste, frozen materials, and other deleterious matter and having a PI < 20.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Excavation is Unclassified and includes excavation to subgrade elevations indicated regardless of character of materials and obstruction encountered.

B. Unauthorized Excavation:

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect/Engineer. Unauthorized excavation, as well as remedial work directed by the Architect/Engineer, shall be at Contractor's expense.
2. Under footings, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Architect/Engineer.
3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavation of same classification, unless otherwise directed by Architect/Engineer.

C. Top Soil:

1. Contractor shall strip 6" of existing topsoil and stockpile on-site at locations specified by owner. The topsoil shall be uniformly spread and graded after earthwork is complete.
- 2.

D. Additional Excavation:

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1. When excavation has reached required subgrade elevations, notify the Architect/Engineer who will make an inspection of conditions.
2. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Architect/Engineer.
3. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.

D. Stability of Excavations:

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

F. Trench Safety Systems:

1. Provide materials for shoring and bracing such as sheet piling, uprights, stringers, and cross-braces in good serviceable condition.
2. Trench shoring and bracing or trench boxes shall be required for trenches exceeding 5 foot in depth.
3. Maintain shoring and bracing or trench boxes in excavations regardless of time period excavations will be open.

G. Dewatering:

1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding property.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well pints, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavation.
3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavation to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

H. Material Storage:

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1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 2. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
 3. Dispose of excess soil material and water materials unless otherwise shown on plans.
- I. Excavation for Structures: (refer to plans)
1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 2. In excavating for footing and foundation, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
- J. Excavation for Pavements:
1. Cut surface under pavements to comply with cross sections, elevations and grades as shown.
- K. Excavation for Trenches:
1. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of pipe or conduit.
 3. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
 5. For RCP Storm Sewer Pipe 12" or larger in nominal size provide a 4" thick embedment material. Approved embedment material shall include sand, blow sand or similar material. No crusher fines will be allowed for embedment material.
 6. Except as otherwise indicated, excavate for exterior water bearing piping (water, sewer, gas and drainage) so top of piping is not less than 3'-6" below finished grade.
 7. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.

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8. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.
 9. For piping or conduit less than 2'-6" below surface of roadways, provide 4" thick concrete base slab support. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.
- L. Cold Weather Protection: Protect excavation bottoms against freezing when atmosphere temperature is less than 35° F. (1° C.).

3.02 COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.
- B. Percentage of Maximum Density Requirements:
 1. Structures, Building Slabs and Steps: Compact top in accordance with Structural Drawings.
 2. Roadways, parking areas and sidewalks: Compact subgrade and each layer of backfill or fill material at 95% standard Proctor ASTM D-698-91 at a moisture content of no more than 3% above optimum moisture for cohesive material or 95% maximum density for cohesionless material.
 3. Open areas: Compact subgrade and each layer of backfill or fill material at 90% standard Proctor ASTM D-698-91 at a moisture content of no more than 3% above optimum moisture for cohesive material or 90% maximum density for cohesionless material.
- C. Moisture Control:
 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compaction operations.
 2. Remove and replace or scarify and air dry soil material that is too wet to permit compaction to specified density.
 3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

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3.03 BACKFILL AND FILL

- A. Under grassed areas, use satisfactory excavated or borrow material.
- B. Under roadway, parking and flatwork use backfill and fill materials that comply with 2.01-3
- C. Under steps, use subbase material.
- D. Under building slabs (refer to structural drawings / specifications)
- E. Under piping and conduit, use subbase material where subbase is indicated under piping or conduit; shape to fit bottom 90° of cylinder.
- F. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Acceptance of construction below finish grade including where applicable, dampproofing, waterproofing, perimeter insulation, inspection, testing, approval, and recording locations of underground utilities.
 - 2. Removal of concrete formwork.
 - 3. Removal of shoring and bracing and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 - 4. Removal of trash and debris.
 - 5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- G. Ground Surface Preparation:
 - 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
 - 2. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- H. Placement and Compaction:

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1. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand operated tampers.
2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture contact. Compact each layer to required percentage of maximum density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.04 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- B. Grading Outside Building Lines:
 1. Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
 2. Finish surfaces free from irregular surface changes, and as follows:
 - a. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
 - b. Sidewalks and Flatwork: Shape surface of areas under walks to line, grade, and cross section, with finish surface not more than 0.10' above or below required subgrade elevation.
 - c. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2" above or below required subgrade elevation.
- C. Grading Surface of Fill under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.

3.05 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

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1. Roadways, Parking Areas and Building Slab Subgrade: Make at least one (1) field density test of subgrade for every 20,000 sq. ft. of paved area or building slab, but in no case less than three (3) tests. In each compacted fill layer, make one (1) field density test for every 10,000 sq. ft. of overlaying building slab or paved area, but in no case less than three (3) tests.
2. All other areas: In each compacted fill layer, make at least one (1) field density test for every 50,000 sq. ft. of fill area, but in no case less than two (2) tests.

If in the opinion of the Architect/Engineer based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.

3.07 MAINTENANCE

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.08 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property.

END OF SECTION

SECTION 02221 - TRENCH EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK

- A. Excavation, shoring, dewatering, pipe bleeding, trench backfill, compaction, grading and cleanup of all pipeline trenching for the project.
- B. All work must be done in accordance with these specifications and the safety requirements of the State and OSHA Standards.

1.02 JOB CONDITIONS

- A. Site Acceptance
 - 1. Accept site in condition existing during Contract time frame.
 - 2. Ground water/surface water found during construction are conditions of the contract and responsibility of Contractor.
- B. Adverse Weather
 - 1. Place no backfill that is excessively wet or frozen.
 - 2. Place no backfill in excessively wet or frozen trenches.

PART 2 - PRODUCT

2.01 PIPE BEDDING AND BACKFILL

- A. The type of bedding shall be stated on the Plans or in the Special Provisions of the contract document. Determination of source of materials for bedding and backfill to meet the stated conditions shall be responsibility of Contractor, but use of such materials shall be subject to approval of Engineer.
- B. Excavated Material Backfill

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1. Excavated material may be used in the trench backfill, provided that all hard rock and stones having any dimensions greater than 6" and frozen earth debris and roots larger than 2" are removed for the initial backfill. Engineer must approve use of excavated backfill material as bedding material.

C. Select Backfill

1. Select Backfill shall be gravel, fine rock cuttings, sand, sandy loam or loam, free from excessive clay. Rock cuttings shall have no dimensions greater than 2 inches. Engineer must approve select backfill.

D. Sand Backfill

1. Sand backfill shall be clean, hard, durable, uncoated grains, free from clay lumps and organic material. All materials must pass a No. 8 Sieve.

E. Granular Backfill

1. Granular backfill shall be free flowing, such as sand or hydraulically graded stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2 inches in diameter, clay and organic matter.

F. Controlled Density Fill

1. Use high slump mixture of portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal. Provide mixture with minimum 28-day compressive strength of 70 psi with no measurable shrinkage or surface settlement.

2.02 CRADLING ROCK

- A. Use crushed rock or stone with 70-100% passing 1½ inch sieve and no more than 50% passing 1 inch sieve.

2.03 SHEETING, SHORING AND BRACING

- A. Use sound timber or structural steel.
- B. Use shapes and sizes as required.

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PART 3 - EXECUTION

3.01 GENERAL

A. Dewatering

1. Execute work "dry". No pipe or conduits shall be laid or concrete poured on excessively wet soil.
2. Prevent surface water from flowing into excavation.
3. Provide equipment for handling water encountered as required. Obtain approval of proposed method of dewatering from the Engineer.
4. No Sanitary sewer shall be used for disposal of trench water.

B. Protection of Existing Utilities:

1. Notify all utilities of location and schedule of work.
2. Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility owners and Engineer of conflicts between existing and proposed facilities.
3. Repair, relay or replace existing utilities damaged, destroyed or disrupted during work. Unless specified otherwise, replacement will be at the Contractors expense.

C. Sheet piling, Shoring and Bracing

1. All sheet piling, shoring, and bracing shall be in accordance with these specifications and the safety requirements of the State and OSHA Standards.
2. Provide as necessary, to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.
3. Leave sheet piling and shoring in place where removal might cause damage to persons or work or as otherwise indicated on drawings.
4. When movable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.

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D. Changes in Grade

1. Grades may be adjusted 1½ feet (plus or minus) from plan grades to suit unforeseen construction conflicts or conditions with approval of Engineer.
2. No additional compensation will be made for such changes.

3.02 EXCAVATION AND TRENCHING

A. General

1. Method of excavation is Contractor's option.
2. Excavate any areas around trees, structures and utilities by hand.
3. Stockpile and replace topsoil to a minimum of 8-inches for surface restoration in grassed or agricultural areas.

B. Trench Characteristics

1. Depth

- a. As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified or indicated.

2. Width

- a. Keep width of trench as narrow as possible with adequate room for backfilling and jointing.
- b. Maximum width as follows:

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<u>Pipe Size Inches</u>	<u>Maximum Trench Width</u>
4	2-feet 0-inches
6	2-feet 0-inches
8	2-feet 4-inches
10	2-feet 4-inches
12	2-feet 6-inches
15	2-feet 9-inches
18	3-feet 0-inches
Over 18	Pipe O.D. + 12-inches

3. Trench walls must be vertical below top of pipe and may be vertical or sloped above pipe to conform to excavating codes.
2. Provide bell holes for each pipe joint where pipe bears on undisturbed earth.
3. Trench bottom shall be free of large stones and other foreign material.

3.03 SOFT, SPONGY OR UNSTABLE MATERIALS

- A. Stop work and notify Engineer.
- B. Perform remedial work as directed.
- C. If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.04 ROCK EXCAVATION

- A. Excavate any rock to maintain minimum 6-inch clearance around pipe.
- B. Dispose of rock material not suitable for backfill as directed by Engineer.

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- C. Use of explosives not permitted without prior written authorization from owner and Engineer.
- D. Provide Special Hazard Insurance covering liability for blasting operations.

3.05 BEDDING

- A. Place after bottom of trench has been excavated to proper depth and grade.
- B. Place, compact and shape bedding material to conform to barrel of pipe to insure continuous firm bedding for full length of pipe.
- C. Provide bedding as described in following table unless indicated otherwise on Plans or in Special Provisions.

<u>Pipe Material</u>	<u>Minimum Bedding Class</u>
1. Vitrified Clay Pipe	Class C*
2. Non-reinforced Concrete Pipe	Class C*
3. Reinforced Concrete Pipe	Class D*
4. Ductile Iron Pipe	Class D*
5. Steel Cylinder	Class C*
6. Flexible or Composite Pipe	Class 1**

*Refers to standard detail

**Refers to standard detail,

3.06 TRENCH BACKFILL

- A. Use excavated material backfill (2.01B) unless otherwise specified.
- B. Use Sand Backfill for all trenches within 5 feet of buildings and beneath walks, parking areas, paved streets or existing exposed utilities.
- C. Initial Backfill
 - 1. Place after pipe has been bedded and checked for alignment, grade and internal obstructions.
 - 2. Carry out in an orderly fashion after authorization to cover pipe has been given.

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3. Allow no more than 300 feet of trench to be open at one time.
4. Do not backfill until concrete or mortar has sufficiently cured.
5. Record location of connections and appurtenances before backfilling.
6. Place by hand and hand tamp to not less than 12-inches above top of pipe, in approximately 4-inch layers.
7. Backfill simultaneously on both sides of pipe to prevent displacement.
8. Place cushion of 4-feet above pipe envelope before using heavy compacting equipment.

D. Subsequent Backfill

1. Place backfill into trench at an angle so that impact on installed pipe is minimized.
2. Compaction of all backfill material shall be performed in a manner that shall not crack, crush, and/or cause the installed pipe to be moved from the established grade and/or alignment.
3. Area under or within 5-feet of pavement; and under or within 2-feet of utilities, buildings, or walks shall be mechanically compacted to the top of the subgrade in 6-inch (8 inch loose measure) lifts to a minimum of 95 % Standard Proctor Density.
4. Areas not subject to vehicular traffic shall be backfilled in layers not more than 12-inches in depth, loose measure, and mechanically compacted.
5. Structural and non structural backfill will be mechanically compacted. Compaction method at discretion of Contractor with following exceptions:
 - a. If in Owner's opinion compaction method presents potential damage to pipe, it will not be allowed.
 - b. Flooding or water jetting may be permitted only if a geotechnical report justifying the use of water jetting is submitted to the Engineer by a qualified laboratory and the Engineer approves.
6. Mound excavated materials in piles no greater than 6-inches in height in open areas only.
7. Fill upper portion of trench with topsoil as specified hereinbefore.

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E. Controlled Density Fill

1. Use where shown on plans.
2. Provide suitable forms to limit volume of control density fill material.
3. Prevent flow of material into existing drain lines.
4. Protect exposed utility lines during placement.
5. Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.07 EXCESS MATERIAL

- A. Store excess excavated material where directed by Engineer.

3.08 TESTING

- A. Unless specified elsewhere, testing will be responsibility of Owner.

B. Standard Proctor Density

1. ASTM D698.
2. One (1) required for each type of material encountered.

C. In Place Density

1. ASTM D1556 (Sand Cone)
2. ASTM D2167 (Balloon)
3. ASTM D3017 (Nuclear)

- D. One (1) test per 250 linear feet of trench on alternating lifts, with a minimum of three tests per visit,

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for non-structural areas. One (1) test per 100 linear feet of trench on alternating lifts, with a minimum of three tests per visit, for structural areas.

- E. Contractor will be responsible for any costs associated with testing performed as a result of failed tests

PART 4 - MEASUREMENT AND PAYMENT

4.01 TRENCH EXCAVATION

- A. Trench excavation shall be considered incidental to pipeline installation.
- B. Payment shall be made at the contract unit price per cubic yard only if a bid item is established in the contract.

4.02 BACKFILL

- A. Payment for backfill shall be made at the contract unit price per cubic yard only if a separate bid item is established in the contract.
- B. No allowance for waste shall be made.
- C. If Engineer orders an initial backfill material other than that specified in contract, it shall be paid for as an extra in price per cubic yard as compacted in place, EXCEPT if a higher class embedment is ordered by Engineer because the Contractor has over-excavated the trench width.
- D. If the Engineer orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item is not established as a bid item, the material shall be paid as an extra.
- E. If the Contractor fails to compact the backfill to the density requirements, the Engineer may order the material removed and replaced at no cost to the Owner.
- F. The disposal of rejected material shall be at no cost to the Owner.

*** * * END OF SECTION * * ***

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SECTION 02223 - FLEXIBLE BASE

PART I - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of furnishing and placing a foundation course for surface courses or for other base courses.
- B. Flexible base shall be composed of either caliche (argillaceous limestone, calcareous or calcareous clay particles, with or without stone, conglomerate, gravel, sand or other granular materials), crushed stone, gravel, iron ore topsoil, shell, or crushed slag.
- C. Flexible base shall be constructed as specified herein in one or more courses in conformance with the details, lines and grades shown on the plans, and as established by the ENGINEER.

PART 2 -PRODUCTS

2.01 MATERIALS:

- A. Materials for flexible base shall be crushed or uncrushed as necessary to comply with the requirements hereinafter specified.
- B. Materials shall consist of durable, coarse aggregate particles mixed with approved binding materials.

2.02 LIME STABILIZATION:

- A. Where shown on the plans, or directed by the ENGINEER, material for flexible base shall be lime stabilized in accordance with Texas Department of Transportation (TXDOT) 2004 Standard Specifications for Construction of Highways, Streets and Bridges. Measurement and payment sections do not apply. Item 260 – Lime Treatment (Road-Mixed).

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2.03 TYPES:

- A. Type A - Crushed or broken aggregate (excluding gravel aggregate).
- B. Type B - Gravel Aggregate
- C. Type C - Iron Ore Topsoil
- D. Type D - Shell Aggregate with Sand Admixture
- E. Type E - Shell Aggregate with Sand and Caliche Admixture
- F. Type F - Caliche
- G. Type G - Crushed Slag
- H. Unless otherwise noted on the plans or directed by the ENGINEER, the CONTRACTOR may use any one type of these types provided the material used meet the requirements set forth in the specification test limits herein.

2.04 GRADES:

- A. Unless otherwise shown on the plans or directed by the ENGINEER, the final course of base material shall consist of Grades 1,2,3, or 4, as specified in Table 02601-1.
- B. Base courses or subbase materials, unless otherwise noted on the plans or directed by the ENGINEER, may consist of Grades 1, 2, 3, or 4, as specified in Table 02601-1.
- C. All grades shall, when tested in accordance with standard laboratory test procedures, meet the physical requirements set forth in Table 02601-1.
- D. Testing of flexible base materials shall be in accordance with the following test procedures:

TEST
Preparation for soil constants
and sieve analysis

TESTING PROCEDURE
TEX-101-E

Liquid Limit

TEX-104-E

Plastic Limit

TEX-105-E

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Plasticity Index	TEX-106-E
Sieve Analysis	TEX-110-E
Wet Ball Mill	TEX-116-E
Triaxial Test	TEX-117-E (Part I or II)

- E. Unless otherwise specified on the plans, samples for testing the material for Soil constants, Gradation and Wet Ball Mill shall be taken prior to the compaction operations.
- F. Unless otherwise specified on the plans, samples for triaxial tests shall be taken from the stockpile or from production, as directed by the ENGINEER, where stockpiling is required and from production where stockpiling is not required.

TABLE 02223-1

PHYSICAL REQUIREMENTS FOR FLEXIBLE BASE MATERIALS

GRADES				
TYPES	Grade 1: (Triaxial class 1) Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	Grade 2: (Triaxial Class 1 to 2.3) Min. com- pressive strength, psi: 35 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	Grade 3: (Unspecified Tri axial Class)	Grade 4: (Unspecified Tri axial Class)
TYPE A	Retained on %	Retained on %	Retained on %	
Crushed or.	Sq. Sieve	Sq. Sieve	Sq. Sieve	
Broken	1-3/4".....0	1-3/4".....0-10	1-3/4".....0-10	
Aggregate	7/8".....10-35	No. 4.....45-75	No. 40.....60-85	As
(excluding	3/8".....30-50	No. 40.....60-85	Max LL.....45	Shown
gravel	No. 4.....45-65	Max LL.....40	Max PI.....15	on
aggregate)	No. 40.....70-85	Max PI.....12	Wet Ball Mill	Plans
	Max LL.....35	Wet Ball Mill	Max Amt.....55	
	Max PI.....10	Max. Amt.....50	Max Increase	
	Wet Ball Mill	Max Increase	in Passing	
	Max Amt40	in Passing	No. 40.....20	
	Max Increase	No. 40.....20		
	in Passing			
	No. 40.....20			

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TYPE B Gravel Aggregate	Retained on % Sq. Sieve 1-3/4".....0-10 No. 4.....30-75 No. 40.....70-85 Max LL.....35 Max PI.....12	Retained on % Sq. Sieve 1-3/4".....0-5 No. 4.....30-75 No. 40.....65-85 Max LL.....35 Max PI.....12	On	As Shown Plans
TYPE C Iron Ore Topsoil	Retained on % Sq. Sieve 2-1/2".....0 No. 40.....50-85 Max LL.....35 Max PI.....12	Retained on % Sq. Sieve 2-3/4".....0 No. 40.....45-85 Max LL.....35 Max PI.....12	on	As Shown Plans
TYPE D Sand-Shell	Retained on % Sq. Sieve 1-3/4".....0-10 No. 4.....45-65 No. 40.....50-70 Max LL.....35 Max PI.....12	Retained % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....12	As	Shown on Plans
TYPE E Shell with Sand and Caliche	Retained % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....10	Retained % Sq. Sieve 1-3/4".....0 No. 40.....45-65 Max LL.....35 Max PI.....12		As Shown on Plans
TYPE F Caliche	Retained % Sq. Sieve 1-3/4".....0 No. 4.....45-75 No. 40.....50-85 Max LL.....40 Max PI.....12	Retained % Sq. Sieve 1-3/4".....0 No. 40.....50-85 Max LL.....40 Max PI.....12		As Shown on Plans
TYPE G Crushed Blast Fur-				As Shown on

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nace Slag

Plans

- G. Materials exhibiting reasonably close conformity with the specified gradation and plasticity index are defined by the following criteria:
1. The ENGINEER may accept the material, providing not more than 2 of 10 consecutive gradation tests performed are outside the specified limits on any individual or combination of sieves by no more than 5% and where no two consecutive tests are outside the specified limits.
 2. The ENGINEER may accept the material providing not more than 2 of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two points and where no two consecutive tests are outside the specified limit.

2.05 STOCKPILING:

- A. When specified on the plans, the material shall be stockpiled prior to delivery on the road. The stockpile shall be not less than the height indicated and shall be made up of layers of material not to exceed the depth shown on the plans.
- B. After a sufficient stockpile has been constructed as specified on the plans, the CONTRACTOR may proceed with loading from the stockpile for delivery to the road.
- C. In loading from the stockpile for delivery to the road, the material shall be loaded by making successive vertical cuts through the entire depth of the stockpile.
- D. If the CONTRACTOR elects to produce the Type A material from more than one material or more than one source, each material shall be crushed separately and placed in separate stockpiles so that at least 75 percent of the material in the course aggregate stockpiles will be retained on the No. 4 sieve and at least 70 percent of the material in the fine aggregate stockpile will pass the No. 4 sieve.
- E. The materials shall be combined in a central mixing plant in the proportions determined by the ENGINEER to produce a uniform mixture which meets all of the requirements of the specification. In the event that combinations of the materials produced fail to meet all of the specification requirements, the CONTRACTOR will be required to secure other materials which will meet specifications requirements.
- F. The central mixing plant shall be of either the batch or continuous flow type, and shall be equipped with feeding and metering devices which will add the materials

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into the mixer in the specified quantities.

G. Mixing shall continue until a uniform mixture is obtained.

PART 3 - EXECUTION

3.01 PREPARATION OF SUBGRADE:

- A. The roadbed shall be excavated and shaped in conformity with the typical sections shown on the plans and to the lines and grades as established by the ENGINEER.
- B. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material.
- C. All holes, ruts and depressions shall be filled with approved material and, if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material.
- D. The surface of the subgrade shall be finished to line and grade as established and in conformity with the typical section shown on plans. Any deviation in excess of 1/2 inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompact by sprinkling and rolling.
- E. Sufficient subgrade shall be prepared in advance to insure satisfactory execution of the work.
- F. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or otherwise disposed of as directed. Any additional material required for the completion of the shoulders and slopes shall be secured from sources indicated on plans or as directed by the ENGINEER.

3.02 PLACEMENT OF FIRST COURSE - TYPE A, TYPE B, TYPE C, TYPE F, AND TYPE G MATERIAL:

- A. Immediately before placing the base material, the subgrade shall be checked as

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to conformity with grade and section.

- B. The material shall be delivered in approved vehicles of a uniform capacity, and it shall be the charge of the CONTRACTOR that the required amount of specified material shall be delivered to each 100-foot station.
- C. Material deposited upon the subgrade shall be spread and shaped the same day.
- D. In the event that inclement weather, or other unforeseen circumstances, render the spreading of the material during the first 24-hour period impractical, the materials shall be scarified and spread as directed by the ENGINEER.
- E. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on plans.
- F. All areas and "nests" of segregated coarse or fine material shall be removed and replaced with well graded material, as directed by the ENGINEER.
- G. If additional binder is considered desirable or necessary after the material is spread and shaped, it shall be furnished and supplied in the amount directed by the ENGINEER. Such binder material shall be carefully and evenly incorporated with the material in place by scarifying, harrowing, brooming or by other approved methods.
- H. The course shall be compacted by methods of compaction hereinafter specified as the "Ordinary Compaction" method or the "Density Control" method of compaction as indicated on the plans, or as directed by the ENGINEER.
 - 1. When the "Ordinary Compaction" method is to be used, the following provisions shall apply:
 - a) The course shall be sprinkled as required and rolled as directed until a uniform compaction is secured. Throughout this entire operation, the shape of the course shall be maintained by blading. Upon completion, the surface shall be smooth and in conformity with the typical sections shown on plans and the established lines and grades.
 - b) In the area on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

- c) All irregularities, depressions and weak spots which develop in the laid course shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
2. When the "Density Control" method of compaction is to be used, the following provisions shall apply:
- a) The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density".
 - b) In addition to the requirement specified for density, the full depth of the flexible base shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment.
 - c) After each section of flexible base is completed, tests as necessary will be made by the ENGINEER. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements.
 - d) Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical sections shown on the plans and to the established lines and grades.
 - e) In the areas on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section and 16 feet in length, measured longitudinally, shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
 - f) All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
- I. Should the base course, due to any reason or cause, lose the required stability, density or finish before the surfacing is complete, it shall be recompact and refinished at the sole expense of the CONTRACTOR.
- J. Where Type C material is used, the material shall be scarified, thoroughly

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wetted, mixed, manipulated, and bladed so as to secure a uniformly wetted material, and pulled in over the subgrade in courses and set under the action of blading and rolling. The work of mixing, blading, rolling, shaping, and subsequent maintenance shall be performed by the continuous use of sufficient number of satisfactory rollers and power maintainers with adequate scarifier attachments.

3.03 PLACEMENT OF FIRST COURSE - TYPE D MATERIAL:

- A. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section, and corrections made if necessary.
- B. All materials shall be delivered in approved vehicles of a uniform capacity.
- C. The required amount of shell shall be uniformly spread across the section and allowed to dry sufficiently to insure proper slaking and mixing of the binder material. Immediately upon completion of the drying period, as determined by the ENGINEER, the specified amount of sand admixture, as required to produce a combined material meeting the requirements hereinbefore specified, shall be spread uniformly across the shell.
- D. The material shall then be sprinkled as required and thoroughly mixed by blading and harrowing, or other approved methods.
- E. Failure to proceed with the placing of sand admixture or mixing and placing operations will be grounds for the suspension of placing of shell.
- F. Under no conditions will the CONTRACTOR be allowed to place an excessive amount of shell without proceeding with the mixing and placing operations.
- G. The course shall be compacted by the method of compaction hereinafter specified as the "Ordinary Compaction" method or the "Density Control" method of compaction as indicated on the plans, or as directed by the ENGINEER.
 - 1. When the plans indicate that the "Ordinary Compaction" method is to be used, the following provisions shall apply:
 - a) After mixing, all material shall be windrowed, and then spread over the section in layers.

- b) The layer shall not exceed 2 inches in loose depth.
 - c) If necessary to prevent segregation, the material shall be wetted in the windrow prior to spreading.
 - d) After each lift is spread, it shall be sprinkled and rolled to secure maximum compaction as directed by the ENGINEER. Succeeding layers shall then be placed similarly until the course is completed.
 - e) All areas and "nests" of segregated coarse or fine material shall be removed and replaced with well graded material, as directed by the ENGINEER.
 - f) The course shall then be sprinkled as required and rolled as directed until a uniform compaction is secured.
 - g) Throughout this entire operation, the shape of the course shall be maintained by blading; and the surface, upon completion, shall be smooth and in conformity with the typical sections shown on plans, and to the established lines and grades.
 - h) In the areas on which pavement is to be placed, any deviation in excess of 1/4 inch in cross section and 16-feet in length, measured longitudinally, shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
 - i) All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling.
2. When the plans indicate that the "Density Control" method of compaction is to be used, the compaction method shall be the same as prescribed for Type A, Type B, Type C, Type F and Type G material.
- H. When indicated on the plans or permitted by the ENGINEER, Type D material may be mixed in a central mixing plant and delivered to the road as a combined mixture. When this method is used, the combined mixture shall meet the requirements for type D material as hereinbefore specified and the placing and compaction requirement shall be the same as prescribed for Type A, Type B, Type C, Type F and Type G material.

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3.03 PLACEMENT OF FIRST COURSE - TYPE E MATERIAL:

- A. The construction methods for placing the first course of Type E material shall be the same as prescribed for Type D material except that after the shell and sand have been placed, the prescribed amount of caliche shall then be spread across the sand and shell.
- B. The composite mixture shall then be sprinkled as required and thoroughly mixed by blading and harrowing or other approved methods.
- C. Compaction of the first course of Type E material shall be the same as prescribed above for Type D material.
- D. Failure to proceed with placing the sand and caliche admixture or mixing and placing operations will be grounds for the suspension of placing of shell.
- E. Under no conditions will the CONTRACTOR be allowed to place an excessive amount of shell without proceeding with the mixing and placing operations.

3.05 PLACEMENT OF SUCCEEDING COURSES - ALL MATERIAL TYPES:

- A. Construction methods shall be the same as prescribed for the first course.
- B. Prior to placing the surfacing on the completed base, the base shall be "dry cured" to the extent directed by the ENGINEER.

3.06 REWORKING AN EXISTING BASE COURSE

- A. Existing base courses shall be reworked in accordance with TxDOT Item 251, or as directed by the ENGINEER, and result in a section that conforms the approved lines and grades.

3.07 DENSITY CONTROL:

- A. When the "Density Control" method of compaction is indicated on the plans, each course of flexible base shall be compacted to the percent density shown on the plans.
- B. The testing will be as outlined in Test Method Tex-114-E.

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- C. It is the intent of this specification to provide that the part of the base included in the top 8 inches, immediately below the finished surface of the roadway, be not less than 100 percent of the density, as determined by the compaction ratio method.
- D. Field density determination shall be made in accordance with Test Method Tex-115-E.

3.08 TOLERANCES:

- A. Flexible base will be measured by the square yard of surface area of completed and accepted work based on the thickness of flexible base as shown on the plans.
 - 1. The ENGINEER may accept the work providing not more than 25 percent of the density tests performed each day are outside the specified density by no more than three pounds per cubic foot and where no two consecutive tests on continuous work are outside the specified limits.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Flexible base will be measure by the square yard of surface area of completed and accepted work based on the thickness of flexible base as shown on the plans.
 - 1. The flexible base shall be measured for depth by the units of 2000 square yards, with one measurement taken at a location selected by the ENGINEER.
 - 2. In that unit where flexible base is deficient by more than 1/2 inch in thickness, the deficiency shall be corrected by scarifying, adding material as required, reshaping and recompacting by sprinkling and rolling.
 - 3. No additional payment over the contract unit price will be made for any flexible base of a thickness exceeding that required by plans.
- B. The CONTRACTOR shall schedule his operations in such a manner as to facilitate the measurement of the pay item.
- C. The ENGINEER may accept the work provided no more than 2 out of 10 depth tests performed are deficient by not more 1/2 inch and where no two consecutive

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tests on continuous work are outside the specified depth.

4.02 PAYMENT:

- A. The accepted quantities of flexible base of the type, grade, and compaction method specified will be paid at the contract unit bid price per square yard, complete and in place.
- B. Where "Ordinary Compaction" is used, all sprinkling, rolling, and manipulation required will not be paid for directly, but will be incidental to other bid items.
- C. The unit prices bid shall each be full compensation for shaping and fine grading the roadbed; for securing and furnishing all materials, including all royalty and freight involved; for furnishing scales and labor involved in weighing the material when required; for loosening, blasting, excavating, screening, crushing and temporary stockpiling when required; for loading all materials for all hauling and delivering on the road; for spreading, mixing, blading, dragging, shaping and finishing, and for all manipulation, labor, tools and incidentals necessary to complete the work.

*** * * END OF SECTION * * ***

SECTION 02238 - REMOVAL OF CONCRETE

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of breaking up, removing and satisfactorily disposing of existing concrete, as classified, at locations indicated or as directed by the Engineer.
- B. Existing concrete, when under this section, will be classified as follows:
 - 1. Concrete Curb will include curb and curb-and-gutter combinations.
 - 2. Concrete Slabs will include, but not be limited to, patio slabs, porch slabs, foundation slabs, concrete riprap and concrete pavement.
 - 3. Sidewalks and Driveways will include concrete sidewalks and driveways.
 - 4. Concrete Walls will include all walls, regardless of height and wall footings.
 - 5. Concrete Steps will include all steps and combinations of walls and steps.
 - 6. Abandoned Foundations will include abandoned Electric Department foundations.
 - 7. Miscellaneous Concrete shall include, but not be limited to, manholes, inlets, junction boxes and headwalls, as indicated by the plans or the Engineer.

PART 2 PRODUCTS

2.01 MORTAR:

- A. Mortar, for repair of existing concrete structures, shall conform to the requirements thereof in Section 03300 - Cast-In-Place Concrete.

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PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS:

- A. Prior to commencing this work, all erosion control and tree protection measures required shall be in place and all utilities located and protected. The existing concrete shall be broken up, removed and disposed of at a permitted disposal site by the Contractor.
- B. Where only a portion of the existing concrete is to be removed and the remaining portion is to continue to serve its purpose, care shall be exercised to avoid damage to the portion that will remain in place.
- C. The existing concrete shall be cut along neat lines when indicated, or as established by the Engineer, by sawing with an appropriate type circular concrete saw to a minimum depth of 1/2 inch.
- D. Any reinforcing steel encountered shall be cut off 1 inch inside of the concrete sawed line. Any existing concrete which is damaged or destroyed beyond the neat lines so established, shall be replaced at the Contractor's expense.
- E. The remaining concrete shall be mortared to protect the reinforcing steel and provide a neat, clean appearance.
- F. When applicable, a minimum of 1 foot of steel length shall be cleaned of all old concrete and left in place to tie into the new construction when reinforcement is encountered in the removed portions of structures to be modified.
- G. All unsuitable material shall be removed and replaced with approved material.
- H. All foundation, walls or other objectionable material shall be removed to a minimum depth of 18 inches below all structures and 12 inches below areas to be vegetated.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Concrete curb and concrete wall, when removed as prescribed above, will be measured by the linear foot, in its original position, regardless of the dimensions or size.

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- B. Concrete slabs and concrete sidewalks and driveways removed as prescribed above will be measured by the square foot in original position, regardless of the thickness and reinforcing.
- C. Concrete steps removed will be measured per linear foot of each individual step tread including the bottom step.
- D. Concrete foundation removed will be measured per each.
- E. Miscellaneous concrete removed will be measured per each.

4.02 PAYMENT:

- A. This item will be paid for at the contract unit price bid for "Removed Concrete Curb", "Removed Concrete Slab", "Remove Concrete Sidewalks and Driveways", "Removed Concrete Foundations" and "Remove Miscellaneous Concrete", which price shall be full compensation for all work herein specified, including the disposal of all material not required in the work, the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.
- B. When not listed as a separate contract pay item, removal of concrete shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work, will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

*****END OF SECTION*****

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SECTION 02241 - PNEUMATIC TIRE ROLLING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of the compaction of embankment, flexible base, surface treatments, or pavements by the operation of approved pneumatic tire rollers.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS:

- A. When used on seal coats, asphaltic surface treatments, and bituminous mixture pavements, the roller shall be self propelled and equipped with smooth tread tires with a tire pressure of 45 psi.
- B. The roller shall be so constructed as to be capable of being operated in both a forward and a reverse direction.
- C. When used on bituminous mixture pavements, the roller shall have suitable provision for moistening the surface of the tires while operating.
- D. When turning is impractical or detrimental to the work and when specifically directed by the ENGINEER, the roller shall be of the self-propelled type.
- E. In lieu of the rolling equipment specified, the CONTRACTOR may operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time, its use shall be discontinued.
- F. Rollers shall be maintained in good repair and operating condition and shall be approved by the ENGINEER.

2.02 LIGHT PNEUMATIC TIRE ROLLER:

- A. The light pneumatic tire roller shall consist of not less than 9 pneumatic tire wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires

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of the forward group, mounted in a rigid frame, and provided with a loading platform or body suitable for ballast loading.

- B. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle.
- C. Under working conditions the pneumatic tire roller shall have an effective rolling width of approximately 60 inches and shall be so designed that by ballast loading the total load can be varied uniformly from 9,000 pounds or less to 18,000 pounds or more.
- D. The roller shall be equipped with tires that will afford ground contact pressures to 45 pounds per square inch or more. The operating load and tire air pressure shall be within the range of the manufacturer's chart. The roller under working conditions shall provide a uniform compression under all wheels.
- E. Individual tire inflation pressures shall be within +5 psi of each other.
- F. The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type and the roller, when drawn or propelled by either type of equipment, shall be considered a light pneumatic tire roller unit.

2.03 MEDIUM PNEUMATIC TIRE ROLLER (TYPE A):

- A. The medium pneumatic tire roller (Type A) shall consist of not less than 7 pneumatic tired wheels, running on axles in such manner that the rear group of tires will cover the entire gap between adjacent tires of the forward group and mounted in a rigid frame and provided with a loading platform or body suitable for ballast loading.
- B. The front axles shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tire roller, under working conditions, shall have an effective rolling width of approximately 84 inches and shall be so designed that, by ballast loading, the total load may be varied uniformly from 23,500 pounds or less to 50,000 pounds or more.
- C. The roller shall be equipped with tires that will afford ground contact pressures to 80 pounds per square inch or more. Individual tire inflation pressures shall be within +5 psi of each other.
- D. The operating load and tire air pressure shall be within the range of the manufacturer's chart.
- E. The pneumatic tire roller shall be drawn by a suitable crawler type tractor, a pneumatic tired tractor, a truck of adequate tractive effort or may be of the self-propelled type.

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- F. The roller, when drawn or propelled by any type of equipment, shall be considered a medium pneumatic tire roller unit.
- G. The power unit shall have adequate tractive effort to properly move the operating roller at variable uniform speeds up to approximately 5 miles per hour.

2.04 MEDIUM PNEUMATIC TIRE ROLLER (Type B):

- A. The medium pneumatic tire roller (Type B) shall conform to the requirements for Medium Pneumatic Tire Roller (Type A) as specified above, except that the roller shall be equipped with tires that will afford ground contact pressures to 90 psi or more.

PART 3 -EXECUTION

3.01 CONSTRUCTION METHODS:

- A. The embankment layer or the base course be sprinkled if directed and rolling with a pneumatic tire roller shall start longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 of width of the pneumatic tire roller.
- B. On super-elevated curves, rolling shall begin at the low sides and progress towards the high sides.
- C. Alternative trips of the roller shall be slightly different in length.
- D. The light pneumatic tire roller shall be operated at speeds between 2 and 6 miles per hour for asphalt surfacing work and all other work.
- E. The medium pneumatic tire roller shall be operated at speeds which produce a satisfactory product.
- F. Sufficient rollers shall be provided to compact the material in a satisfactory manner. When operations are so isolated from one another that 1 roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided.

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PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

- A. No additional compensation will be made for materials, equipment or labor required by this item, but shall be considered subsidiary to the various items of the contract.

*** * * END OF SECTION * * ***

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SECTION 02242 - PROOF ROLLING

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION WORK:

- A. This work shall consist of furnishing and operating heavy, pneumatic-tired, compaction equipment for testing the compaction of embankment, subgrade or flexible base.
- B. Proof roll is to be used to locate unstable areas.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. The proof rolling equipment shall consist of not less than 4 pneumatic tired wheels, running on axles carrying not more than 2 wheels, mounted in a rigid frame, and provided with a loading platform or a body suitable for ballast loading.
- B. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.
- C. Under working conditions the proof roller shall have a rolling width of 8 feet to 10 feet and shall be so designed that by ballast loading the gross load may be varied uniformly from 25 tons to 50 tons.
- D. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch. The operating load and tire pressure shall be within the range of the manufacturer's chart and as directed by the ENGINEER.
- E. The proof roller may be of the self-propelled type or shall be drawn by a suitable crawler-type tractor or a rubber tired tractor of adequate tractive effort. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.
- F. Rubber tired tractive equipment shall be used on base courses.
- G. Other type tractive equipment may be used on embankment subgrade.
- H. The heavy pneumatic tired roller unit shall be capable of turning 180 degrees in the crown width.
- I. In lieu of the rolling equipment specified, the CONTRACTOR may, upon written permission from the ENGINEER, operate other equipment that will produce equivalent results as the specified equipment. If the substituted equipment fails to produce the desired results as would be expected of the specified equipment as determined by the ENGINEER, its use shall be discontinued.

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PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS:

- A. This work shall be done to proof all prepared subgrade and flexible base courses or as directed by the ENGINEER.
- B. On embankment compaction, each layer will be placed to specified thickness at optimum moisture and compacted with conventional equipment to comply with the requirements of the governing embankment item.
- C. Prior to placing the overlaying course, the layer shall be proof rolled as directed by the ENGINEER.
- D. When the operation of the proof rolling unit shows an area to be unstable or nonuniform, such area shall be brought to satisfactory stability and uniformity by additional compaction or by removal of unsuitable materials and replacement with suitable materials and recompact.
- E. The surface tested shall then be checked for conformity with line and grade and any irregularities corrected.
- F. Roller shall be operated at speeds between 2 and 6 miles per hour or as directed by the ENGINEER.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

- A. No additional payment will be made for the materials, equipment or labor required by this item and shall be considered subsidiary to the various items included in the contract.

*** * * END OF SECTION * * ***

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SECTION 02250 - PRIME COAT

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION:

- A. Prime coat shall consist of the application of asphaltic materials on a completed base course and/or other approved area, which shall be applied in accordance with these specifications, as shown on the plans, and as directed by the ENGINEER.

1.02 QUALITY ASSURANCE:

A. Test and Certification of Bituminous Materials.

1. Bituminous materials to be tested in accordance with the requirements of AASHTO M-82 and sampled in conformance with AASHTO T-40.
2. Supply, at the time of delivery of each shipment of asphalt, two certified copies of test reports from the supplying vendor to the ENGINEER.
3. Test reports shall indicate name of vendor, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and result of specified tests.

The test report shall be signed by an authorized representative of the vendor and certify that the product delivered conforms to the specifications for type and grade indicated.

Certified test reports and the testing required in the preparation of such report shall be at no cost to the Owner.

4. Final acceptance of bituminous materials shall be dependent on the determination by the ENGINEER that the material meets prescribed standards.

PART 2- PRODUCTS

2.01 MEDIUM CURING CUTBACK ASPHALT:

- A. Medium-curing liquid asphalt, designated by the letters MC, shall consist of an uncracked petroleum base stock, produced by the processing of asphaltic or semi-asphaltic base crude petroleum, blended with a kerosene-type solvent. The base stock for

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all MC materials shall be straight run asphalt produced within the penetration range of 100 to 300, and the end point of the kerosene type solvent shall not exceed 525° F. Medium curing liquid cutback asphalt shall be free from water and show no separation.

- B. Medium curing cutback asphalt shall consist of materials specified above and conforming to the requirements set forth in Table 2250-1.

TABLE 2250-1

Specification Designation	AASHTO Test Method	ASTM Test Method	MC 30	MC 70	MC 250	MC 800	MC 3000
Flash Point (Open Cleave) °F, Min.	T 48	D 92	100	100	150	150	150
Viscosity, 140°F, Kinematic, CS	T 201	D 2170	30 - 60	70 - 140	250 - 500	800 - 1600	3000 - 6000
Furol Viscosity at: 77° F (Sec.) 122° F (Sec.) 140° F (Sec.) 180° F (Sec.)	T 72	D 88	75-150	60-120	125-250	100-200	300-600
Distillation Distillate (% of Total Distillate to 680° F) 437° F 500° F 600° F	T 78	D 402	0-25 40-70 75-93	0-20 25-60 75-90	0-10 20-55 70-85	0 10-35 65-80	0 0-15 50-75
Residue from Distillation to 680° F Volume % by Difference Min.			50	55	67	75	80
Tests on Residue from Distillation Penetration at 77° F	T 49	D 5	120 - 250	120 - 250	120 - 250	120 - 250	120 - 250
* Ductility 77° F, cm, Min.	T 51	D 113	100	100	100	100	100
Solubility in CCl ₄ , % Min.	T 44		99.5	99.5	99.5	99.5	99.5
Water, % Max.	T 55	D 95	0.2	0.2	0.2	0.2	0.2
Reaction to Spot Test	T 102**		0	0	0	0	0

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- * If penetration of residue is more than 200 and its ductility at 77° F is less than 100, the material will be acceptable if the ductility at 60° F is greater than 100.
- ** Using 85% Standard Naptha and 15% Xylene.

NOTE: Viscosity tests may be made by either Kinematic or Furol test methods.

- C. Unless otherwise noted on the plans or directed by the ENGINEER, cutback asphalt Grade MC-30 shall be used.

2.02 BLOTTER MATERIAL:

- A. Supply blotter material consisting of native sand and/or sweepings from base course.
- B. Native sand shall be local material obtained from approved sources as approved by the ENGINEER.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS:

- A. Unless otherwise specified on the plans or required by the ENGINEER, only asphaltic material shall be used. Where required, a combination of asphaltic and blotter material shall be used.
- B. Application of Asphaltic Materials Only.
 - 1. Apply prime coat to prepared surface when ambient air temperature is above 40° F and rising and shall not be applied when the ambient air temperature is below 50° F and falling.
 - 2. Apply prime coat to surfaces that have been cleaned by sweeping or other approved methods and where base is thoroughly dry and satisfactory for receiving prime coat.
 - 3. Apply prime coat to cleaned base, at a rate of 0.2 to 0.5 gallons per square yard of surface area, using an approved type of self-propelled pressure distributor so constructed and operated to distribute the material evenly and smoothly.

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4. Provide necessary facilities for the determination of temperature of asphaltic material in all heating equipment and distributors; and for determination of rate at which it is applied; and for securing uniformity at the junction of two distributor loads.
5. Keep in clean and good working condition all storage tanks, piping, reports, booster tanks and distributors used in the storage and handling of asphaltic materials.
6. Operate all associated equipment in a manner such that there is no contamination of asphaltic material with foreign material.
7. Calibrate distributor and furnish ENGINEER with an accurate and satisfactory record of such calibrations.
8. Recalibrate distributor, in a manner satisfactory to the ENGINEER, after the beginning of work, should the yield on the asphaltic material applied appear to be in error.
9. No traffic, hauling or placing of subsequent courses shall be permitted over freshly applied prime coat until authorized by the ENGINEER.
10. Apply asphaltic material at a temperature within 15° F of temperature of application selected by the ENGINEER based on temperature viscosity relationship noted in Table 2250-1.
11. Maintain surface until work is Blotter Material.

C. Application of Asphaltic and Blotter Material

1. Haul blotter material in vehicles of uniform capacity and placed on shoulders at spacings designated by the ENGINEER.
2. After application of asphaltic material as specified above, cover surface with blotter material as directed by the ENGINEER.
3. After application of blotter material, drag surface with approved drag broom, evenly and smoothly distributing the blotter material. Brooming or dragging operation shall continue, as directed by the ENGINEER, until the course has properly cured under traffic.

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PART 4 - MEASUREMENT AND PAYMENT

4.01 PRIME COAT:

- A. Asphaltic material for prime coat will be measured for payment at point of delivery on the project in gallons at applied temperature. Payment will be paid at the unit bid price for "Prime Coat".
- B. When not listed as a separate contract pay item, prime coat shall be considered as incidental work, and the cost thereof shall be included in such contract pay item(s) as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all material, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

4.02 BLOTTER MATERIALS:

- A. Blotter material will be considered incidental to asphaltic material for prime coat with no direct payment.

*** * * END OF SECTION * * ***

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SECTION 02514 – CONCRETE FLATWORK, CURBS, & APPROACHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Extent of portland cement concrete paving is shown on drawings including walks, curbs, and approaches.

1.03 QUALITY ASSURANCE

- A. Codes and Standards: Comply with local governing regulations.

1.04 JOB CONDITIONS

- A. Traffic Control:
 - 1. Maintain access for vehicular and pedestrian traffic as required for other construction activities.
 - 2. Utilize barricades and warning signs as required.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 1. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 2. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets, not rolls, unless otherwise acceptable to Architect.
- C. Reinforcing Bars: Deformed steel bars ASTM A615, Grade 40.

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- D. Fabricated Bar Mats: Welded or clip assembled steel bar or rod mats, ASTM A184. Use ASTM A615, Grade 40 steel bars, unless otherwise indicated.
- E. Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 40. Cut bars true to length with ends square and free of burrs.
- F. Concrete Materials:
 - 1. Portland Cement: ASTM C 150, Type I
 - a. Use one brand cement throughout project, unless otherwise acceptable to Architect.
 - 2. Normal Weight Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source for exposed concrete.
 - a. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling causing deleterious substances.
 - b. Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Architect.
- G. Expansion Joint Materials: Contractor shall use pre-formed expansion joint fillers and sealers.
- H. Liquid Membrane Forming Curing Compound: Complying with ASTM C309, Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.
 - 1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Masterseal", Master Builders
 - b. "Clear Seal", A.C. Horn
 - c. "Sure Cure", Kaufman Products, Inc.
 - d. "Sealkure", Toch Div. - Carboline
 - e. "Kure-N-Seal", Sonneborn-Contech
 - f. "Sonocrete", Sonneborn-Contech
 - h. "L&M Cure", L&M Construction Chemicals
- I. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.

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1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Weldcrete", Larsen Products
 - b. "Everbond", L&M Construction Chemicals
 - c. "Hornweld", A.C. Horn
 - d. "Sonocrete", Sonneborn-Contech
 - e. "Acrylic Bondcrete", The Burke Co.

2.02 CONCRETE MIX, DESIGN, AND TESTING

- A. Design mix to product normal weight concrete consisting of portland cement, aggregate, and water to produce the following properties.
 1. Compressive Strength: 3000 psi, minimum at 28 days, unless otherwise indicated.
 2. Slump Range: 5" for concrete containing HRWR admixture (super-plasticizer); 3" for other concrete.
 3. Air Content: 5% to 8%.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Proof roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.02 FORM CONSTRUCTION

- A. Set forms to required grades and lines rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least twenty four (24) hours after concrete placement.
- B. Check completed formwork for grade and alignment to following tolerances:
 1. Top of forms not more than 1/8" in 10'.
 2. Vertical face on longitudinal axis, not more than 1/4" in 10'.

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- C. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

3.03 REINFORCEMENT

- A. Locate, place, and support reinforcement as specified in this section unless otherwise indicated on plans.
- B. General: 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.
- C. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
- D. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- E. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.
- F. Place reinforcement to obtain at least minimum coverage's 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.
- G. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.04 CONCRETE PLACEMENT

- A. General: Comply with requirements of Division 3 sections for mixing and placing concrete and as herein specified.
 - 1. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
 - 2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square faced shovels

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for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

3. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

B. Fabricated Bar Mats:

1. Keep mats clean and free from excessive rust and handle units to keep them flat and free of distortions. Straighten bends, kinks, or other irregularities or replace units as required before placement. Set mats for a minimum 2" overlap to adjacent mats.
2. Place concrete in 2 operations; strike-off initial pour for entire width of placement and to the required depth below finish surface. Lay fabricated bar mats immediately in final position. Place top layer of concrete, strike-off and screed.
 - a. Remove and replace portions of bottom layer of concrete which has been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.

- C. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

3.05 JOINTS

- A. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the center line unless otherwise indicated.
1. When joining existing structures, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness as follows:
1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

2. Sawed Joints: (Contractor's Option) Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
- C. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.
1. Construct joints as shown or, if not shown, use standard metal keyway-section forms.
 2. Where load transfer slip dowel devices are used, install so that one end of each dowel bar is free to move.
- D. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
1. Locate expansion joints at 50' o.c. for each pavement lane, unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 3. Furnish joint fillers in one piece lengths for full width being placed wherever possible where more than one length is required, lace or clip joint filler sections together.
 4. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.
- E. Fillers and Sealants: Comply with requirements of applicable Division 7 sections for preparation of joints, materials, installation, and performance.

3.06 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities and refloat repaired areas to provide a continuous smooth finish.

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- C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool and round to 1/2" radius unless otherwise indicated. Eliminate tool marks on concrete surface.
- D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing as follows:
 - 1. Broom finish by drawing a fine hair broom across concrete surface perpendicular to the line of traffic. Repeat operation, if required, to provide a fine line texture acceptable to Architect.
 - 2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff bristled broom perpendicular to the line of traffic.
- E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects as directed by Architect.

3.07 CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling. 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 7 days.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
 - 1. Provide moisture curing by one of the following methods.
 - 2. Keep concrete surface continuously wet by covering with water.
 - 3. Use continuous water-fog spray.
 - 4. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet.
 - 5. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
 - 6. Provide moisture-cover curing as follows:

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- a. Cover concrete surfaces with moisture-retarding cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by water proof tape or adhesive.
- b. Immediately repair any holes or tears during curing period using cover material and water proof tape.
- c. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:
 - i. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen as disappeared).
 - ii. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions.
 - iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
 - iv. Maintain continuity of coating and repair damage during curing period.
 - v. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied to concrete.

3.08 REPAIRS AND PROTECTIONS

- A. Repair or replace broken or defective concrete as directed by Architect.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

END OF SECTION

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SECTION 02570 - SANITARY SEWERS

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- A. Trenching, Backfilling and Compacting: Section 02221.

1.02 SUBMITTAL

- A. Submit manufacturer's certification that products meet specification requirements.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials on manufacturer's original skids or in original unopened protective packaging. Owner reserves the right to reject material left from another job.
- B. Store materials to prevent physical damage.
- C. Protect materials during transportation and installation to avoid physical damage.

1.04 GENERAL DESCRIPTION OF WORK COVERED

- A. Furnish and install all sewer pipe, fittings and structures, and accessories required for sanitary sewer construction as indicated.

1.05 QUALITY ASSURANCE

- A. Comply with latest published editions of American Society of Testing and Materials (ASTM) Standards:
 - 1. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 2. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 3. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

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4. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
5. ASTM F794 - Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
6. ASTM F679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings (SDR35).
7. ASTM F949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
8. ANSI A21.11 - Rubber Gasket Joints for Cast Iron and Ductile- Iron Pressure Pipe and Fittings.
9. ASTM D3753 - Standard Specification for Glass Fiber Reinforced Polyester Manholes.
10. ASTM C-923 - Standard Specification for Resilient Manhole Connectors.
11. ASTM C-478 - Specification for Pre-cast Reinforced Concrete Manhole Sections.
12. ASTM C-443 - Specification for Joints for Circular Concrete Sewer and Culvert pipe using Rubber Gaskets.
13. ASTM C-1244 - Specification for Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
14. AWWA C-151 - Specification for Ductile Iron Pipe and Fittings.
15. ASTM D-1248 - Standard specification for Polyethylene Plastics Molding and Extrusion Materials.
16. AWWA C-105 - Polyethylene Encasement for Gray and Ductile Cast -Iron Piping for Water and Other Liquids.
17. AWWA C-110 - Gray Iron And Ductile Iron Fittings 3-inch through 48-inch, for Water and Other Liquids.
18. ASTM D-3350 - Specification for Polyethylene Plastic Pipe and Fittings Materials.

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19. ASTM F-714 - Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (3-inch IPS and larger).
20. ASTM D-3261 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing.
21. ASTM D-1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds, and Chlorinated Poly (Vinyl Chloride) (CPVC) Compound.
22. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch for water distribution.
23. AWWA C905 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameter 14-inch through 36-inch.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Pipe furnished may be any one of materials specified herein for sanitary sewer construction unless shown otherwise on plans or bid forms.
- B. All pipe shall be marked in accordance with applicable standard specification under which pipe is manufactured unless otherwise specified.

2.02 POLYETHYLENE PIPE AND FITTINGS (PE)

- A. Comply with ASTM D3350 and ASTM F-714 for polyethylene (PE) solid wall pipe and fittings for use in pressure sanitary sewers. Wall thickness shall be as shown on the plans.
- B. Fittings shall comply with the performance requirements of ASTM D2683 or ASTM D3261 for molded or fabricated fittings of the size and pressure class as required.
- C. Provide pipe and fittings with minimum performance requirements of ASTM D 1248, Type III Class C, Category 5, Grade P34 and ASTM D3350 as indicated in this specification and as shown in the plans and details.

2.03 POLYVINYL CHLORIDE PLASTIC PIPE (PVC)

- A. Comply with ASTM D3033, D3034, ASTM F679, CT-1 walls, or ASTM F-794 for pipe using

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material conforming to ASTM D1784 for pipe and fittings.

1. Sewers 6-inches to 10-inches shall conform to ASTM D3034.
 2. Sewers 12-inches to 30-inches shall conform to ASTM D3034, ASTM F-679 (T-1 wall), or ASTM F-794 for pipe using material conforming to ASTM D1784 for pipe and fitting.
 3. Sewers 36-inches and larger shall conform to ASTM F-949, ASTM D3034, ASTM F-679 or ASTM F-794 for pipe using material conforming to ASTM D1784 for pipe and fitting.
- B. Use single elastomeric gasket push-on joints complying with ASTM D3212.
- C. Provide pipe and fittings with minimum performance capabilities of SDR-35 dimension ratio for gravity sewers of less than 10-feet in depth or cover. Where directed by the Engineer and as indicated on the plans, sewers greater than 10-feet in depth shall meet SDR26 or AWWA C900 or C905 requirements.
- D. Lubricant to be in accordance with the requirements of ASTM D3212. Lubricant to be suitable for lubricating the parts of the joints in the assembly. The lubricant to not have any deteriorating effects on the gasket and pipe materials.
- E. Schedule 40 shall be used for service laterals.
- F. Mark all pipe and fittings.

2.04 DUCTILE IRON PIPE AND FITTINGS

- A. Comply with the latest published edition of American Water Works Association (AWWA) Standards:
1. AWWA C110 & C110a - Gray Iron and Ductile-Iron Fittings, 2-inch through 48-inch for water and other liquids.
 2. AWWA C111 - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.
 3. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
 4. AWWA C151 - Ductile-Iron Pipe, centrifugally cast in metal mold or sand lined molds,

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for water or other liquids.

5. AWWA C153 - Ductile-Iron Compact fittings, 3-inch through 12-inch for water and other liquids.
6. ASSA C900 - Polyvinyl Chloride (PVC) Pressure Pipe 4-inches through 12-inches for water.
7. Polyethylene encasement for the protection of ductile and cast iron pipes, fittings valves, and appurtenances shall be furnished and installed in accordance with the requirements of AWWA C-105.
8. Lining and Coating- Ductile and cast iron pipes, fittings valves, and appurtenances for sanitary sewer service shall be furnished with corrosion resistant interior lining furnished by the manufacturer:
 1. Polyethylene "polybond"
 2. Polyurethane "Corropipe II TX 5"
 3. Ceramic-Epoxy "Protecto 401"
 4. Engineer Approved Equal
9. Exterior Coating - Ductile and cast iron pipes, fittings valves, and appurtenances for sanitary sewer service shall be furnished with outside surfaces coated with a bituminous coating 1 mil thick in accordance with ANSI A21.6 or ANSI A21.51.

2.05 MANHOLES, STRUCTURES AND PIPE ACCESSORIES

A. Fittings

1. Fittings allowed only on service laterals.
2. Fittings shall equal or exceed quality of pipe. Fittings shall be full-bodied gasket fittings or inserted gasketed compression fittings on line size greater than 15-inches as shown in the plans and details.

B. Pre-cast Reinforced Concrete Manholes & Sections

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1. Pre-cast reinforced concrete manhole base sections, riser sections, tops, cones and special sections shall conform to the requirements of ASTM C 478-93. The pre-cast sections shall have rubber gasket compression joints conforming to the material and performance requirements of ASTM C 443.
2. Pre-cast Concrete Manhole Base: A steel reinforced concrete base shall be used with pre-cast concrete manhole sections. This base shall be furnished with confined O-ring joints in conformance with ASTM C 443. The reinforced concrete pre-cast manhole base as shown on the plans shall be manufactured in accordance with ASTM C 478.
3. Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923.
4. Minimum wall thickness will be 5-inches.
5. Concrete and reinforcing steel in foundation shall comply with Section 03300.

C. Cast-in-Place Manholes

1. Concrete and reinforcing steel shall comply with Section 03300.
2. Minimum wall thickness will be 5-inches.
3. Provide cast-in-place rubber gasket for connection of required sewer line or watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923.

D. Fiberglass Manholes

1. Fiberglass manholes shall be in accordance with ASTM D3753 "Glass Fiber Reinforced Polyester Manholes, latest revision. The minimum wall thickness for all manholes at all depths shall be .40-inches. The inside diameter of the manhole barrel shall be either 48-inches or 1.5 times the nominal pipe diameter of the largest pipe, which ever is larger, or as indicated on the plan sheets. A concentric reducer over the barrel of the have an inside diameter of 23-inches.
2. Pipe Connectors - Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923 or shall be InsertaTee as shown in the plans and specification

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details. Joints for sewer pipe for line and drop connections in sizes 4-inches - 15-inches shall be made by means of gasketed inserted watertight compression connection or approved equal as shown in the plans and details. Install in accordance with the manufacturer's written instructions. Connections for pipe larger than 15-inches shall be made using a pre-approved connection. Install in accordance with the manufacturer's written instructions.

E. Manhole Accessories

1. Manhole lid and cover:
 - a. Gray cast iron, with minimum clear opening 24- inches.
 - b. Use Western Iron Works A770R or approved equal with vent holes.
 - c. Provide anchor bolt holes for exposed manhole tops.
2. Manhole Rings:
 - a. Provide minimum of three throat rings between cone and manhole
 - b. lid and cover.
3. Coating - Coating and lining of the interior vertical surfaces, if required, shall be as noted in the plans and details. Materials shall be installed and applied in accordance with the written instructions and specifications of the manufacturer at the thickness and quality as noted in the plans and details as approved by Engineer.
4. Manhole Inserts -Provide manhole insert to fit the manhole frame rim upon which the manhole cover rests.
 - a. Insert body shall be made of high density polyethylene copolymer material that meets ASTM D 1248, Class A, Category 5, Type III. Minimum thickness 1/8-inch.
 - b. Gasket shall be of closed cell neoprene and have pressure sensitive adhesive on one side and be placed under the weight-bearing surface of the insert by the manufacturer.
 - c. Lift strap of 1-inch woven polyethylene (seared on all cut ends to prevent

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unraveling. Strap shall be attached to the rising edge of the bowl off the insert by means of stainless steel rivet and washer.

- d. Vent shall have 1/8-inch hole located on the side wall of the insert 3/4-inch below the lip.
- e. Load capacity insert shall have certified test data verifying minimum collapse load of 1500 lbs. minimum applied to a 5.50-inch square area in the center of the insert.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Provide all labor, equipment and materials and install all pipe, fittings, specials and appurtenances as indicated or specified.

3.02 PIPE INSTALLATION

A. Handling

- 1. Handle in a manner to insure installation in sound and undamaged condition.
 - a. Do not drop or bump.
 - b. Use slings, lifting lugs, hooks and usher devices designed to protect pipe, joint elements, and coatings.
- 2. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
- 3. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

B. Installation

- 1. Installation, jointing and testing of pipe, fittings, and accessories shall be in accordance with the provisions of the applicable reference standard and in accordance with the requirements of this specification and related specifications referenced or contained in the contract documents for pressure or gravity sewers.

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2. Lay pipe to slope gradient noted on the drawings.
3. Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.
 - a. Do not lay on blocks unless pipe is to receive total con-crete encasement.
 - b. Use laser or minimum of 3 batter boards for control of line and grade.
 - c. Obtain approval from Engineer for method proposed for transfer of line and grade from control to the work.
4. Install pipe of size, material, strength class, and joint type with embedment shown for plan location.
5. Insofar as possible, commence laying of pipe at downstream end of line, and, install pipe with bell ends in direction of pipe laying. Sewer pipe shall have spigot ends in direction of flow. Obtain approval for deviations therefrom.
6. Clean interior of all pipe, fittings and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.
 - a. Close open ends of pipe with snug fitting closures.
 - b. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate.
 - c. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.
7. Inspect pipe prior to installation to determine if any pipe defects are present.
8. Brace or anchor as required to prevent displacement after establishing final position.
9. Perform only when weather and trench conditions are suitable.
10. Observe extra precaution when hazardous atmospheres might be encountered.
11. Sanitary sewer relation to water mains:

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- a. Maintain 9-feet horizontal separation whenever possible.
- b. When conditions prevent a lateral separation of 9- feet, sewer may be installed closer to a water main if:
 - (1) sewer constructed of PVC pipe meeting AWWA Specifications and having a minimum working pressure rating of 150 psi or greater and equipped with pressure type joints, and;
 - (2) the sewer line and water main are separated by a minimum vertical distance of 2-feet and a minimum horizontal distance of 4-feet, measured between the nearest outside diameters of the pipes.
- c. When a sanitary sewer crosses a water line and that portion of the sewer is constructed as described in 3.02 B.9.b.(1), the sewer may be placed no closer than 6 inches from the water line. The separation distance must be measured between the nearest outside pipe diameters. The sewer line shall be located at a lower elevation than the water line whenever possible and one length of the sewer pipe must be centered on the water line.

12. Auger or jack casing pipe in place where shown on plans.

C. Jointing

1. General requirements:

- a. Locate joint to provide for differential movement at changes in type of pipe embedment, at changes from rock to soil trench bottom, and structures.
 - (1) Not more than 18 inches from structure wall, or
 - (2) Support pipe from wall to first joint with concrete cradle structurally continuous with base slab or footing of structure.
- b. Perform in accordance with manufacturer's recommendations.
- c. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
- d. Utilize methods and equipment capable of fully homing or making up joints without damage.

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- e. Check joint opening and deflection for specification limits.

D. Closure Pieces

1. Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.
2. Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.

E. Temporary Plugs

1. Furnish and install temporary plugs at each end of work for removal by others when completed ahead of adjacent contract or where indicated.
2. Remove from pipe laid under adjacent contract in order to complete pipe connection when work by other contractor is finished prior to work at connection point under this contract.
3. Plugs
 - a. Use test plugs as manufactured by pipe supplier, or
 - b. Fabricate by Contractor of substantial construction.
 - c. Must be watertight against heads up to 20 feet of water.
 - d. Secure in place in a manner to facilitate removal when required to connect pipe.

3.03 MANHOLE INSTALLATION

- A. Foundations to be poured in place, or to be pre-cast concrete base sections in accordance with the requirements of ASTM C-478. See Standard Details included herein.
- B. Construct manhole foundation and channel inverts integrally for cast in place manhole foundations. See Standard Details included herein.
- C. Pre-cast manhole sections of ruse with cast in place manhole bases may be installed after foundation concrete has attained 75% of design strength.

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- D. Forms for cast-in-place manhole may be installed after foundation concrete has attained 75% of design strength.
- E. Manhole foundation and manhole may be installed simultaneously if manhole section is supported on concrete blocks and foundation concrete placed under and around bottom section.
- F. Install manhole sections and joints in accordance with the requirements of the specification.
- G. Heat materials for casting in place in freezing weather and protect work from cold; maintain temperature of work at 40° F. for at least 24 hours after placing.
- H. Invert Channels: Inverts: The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes.
 - 1. For manholes connected to pipes less than 15-inches in diameter the channel depth shall be at least half the largest pipe diameter.
 - 2. For manholes connected to pipes 15 to 24-inches in diameter the channel depth shall be at least three fourths the largest pipe diameter.
 - 3. For manholes connected to pipes greater than 24-inches in diameter the channel depth shall be at least equal to the largest pipe diameter.
 - 4. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5-inch per foot.
 - 5. Where sewer lines enter the manhole higher than 24- inches above the manhole invert, the invert shall be filleted to prevent solids deposition.
 - 6. Drop Manholes: A drop manhole as shown in the details shall be provided for a sewer entering a manhole more than 30-inches above the insert. A drop pipe of the same pipe material and size shall be provided for a sewer pipe entering a manhole more than 24-inches above the invert. The drop pipe shall be constructed on the outside of the manhole utilizing Wyes and Ells to provide a smooth drop and a clean out leg as shown on the details. The drop pipe shall be encased with concrete unless otherwise directed by the Engineer. Concrete shall extend from the bottom of the manhole base up to the bottom of the incoming sewer pipe, concrete shall also extend from the outside wall of the manhole out past the Wye on the Wye branch with a minimum of six inches (6") on

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each side.

I. Pipe Connection

1. Make watertight.
2. Use rubber gasket or size on size resilient connectors allowing for differential settlement conforming to ASTM C-9232.
3. All connections shall be at flowline of manhole.

J. Exterior Pipe Support (Rigid Pipe)

1. Support vitrified clay pipe on concrete cradle from manhole connection to first joint on each side of manhole as indicated.
2. Provide pipe joint within 18 inches of manhole wall.

K. Castings, frames, and fittings

1. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed.
2. The unit shall be protected until mortar or concrete is set.

L. Coatings if required in the specifications and details shall be applied after Engineer's approval of structure.

3.04 ACCEPTANCE TESTS FOR SEWER PIPELINES

A. Infiltration Testing

1. General
 - a. Maximum infiltration for each section of sewer pipe shall not exceed 50 gal/mile/day/inch of pipe diameter.
 - b. Infiltration, exfiltration or air test may be used to prove compliance with infiltration requirement.

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- c. Acceptance of air test or exfiltration results will not preclude rejection of work if infiltration is measured and exceeds limitation.
- d. After backfilling and removing debris from each section of sewer line, conduct a line acceptance test under observation of the Engineer. Copies of all test results shall be made available to the Engineer upon request. Test the sanitary sewer lines in strict accordance with the following leakage test using low pressure air. If the test results indicate an unacceptable installation, locate the source of leakage, correct the defect, and retest until the installation is proven satisfactory.
- e. Tests should conform to the following requirements:
 - (1) Infiltration or Exfiltration Tests. The total exfiltration as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter, per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole.
 - (2) When pipes are installed below the groundwater level an infiltration test shall be used in lieu of the exfiltration test. The total infiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of two feet above the crown of the pipe at the upstream manhole, or at least two feet above existing groundwater level, whichever is greater.
 - (3) For construction within the 25 year flood plan, the infiltration or exfiltration shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.
 - (4) If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, remedial action shall be undertaken in order to reduce the infiltration or exfiltration to an amount within the limits specified.

2. Air Test

- a. Furnish all facilities required including: (1) Necessary piping connections. (2) Test pumping equipment. (3) Pressure gauges or manometers. (4) Bulkheads. (5) All miscellaneous items required.
- b. Obtain approval from Engineer of equipment and methods proposed for use.
- c. Test pipe in sections determined by Contractor and approved by Engineer.

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- d. Plug ends of line and cap or plug all connections to with-stand internal test pressures.
- e. Introduce low pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe. (Add 0.43 psi for each vertical foot of ground water over the top of pipe.)
- f. Allow two minutes for air pressure to stabilize.
- g. Time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of any ground water above pipe shall not be less than time in following table for given diameters.

AIR TESTING TIMING

<u>Pipe Diameter</u> <u>(Inches)</u>	<u>Minutes</u>
6	3.0
8	4.0
10	5.0
12	5.5
15	7.0
18	8.5
21	10.0
24	11.5
27	12.75
30	14.0
36	17.0

- h. Repeat test as necessary after all leaks and defects have been repaired.

C. Deflection Testing

- 1. Perform on flexible pipe.
- 2. Use a mandrel to test for a maximum 5 percent deflection unless otherwise specified in the contract document.
- 3. The mandrel shall be sized and constructed as listed on the applicable table on page

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02570-1.

4. Conduct no sooner than thirty (30) days after final backfill.
5. Use no mechanical pulling devices.
6. Uncover all irregularity or pipe deformation exceeding 5%. Replace all damaged pipe reround non-damaged pipe and tamp the embedment and initial backfill.
7. Any pipe removed shall be replaced by use of gasketed repair couplings.
8. Conduct deflection test in the presence of the Owner's or Engineer's representative.
9. Manhole Testing: Successful passage of a vacuum or hydrostatic test shall be required for acceptance of all sanitary sewer manholes and sanitary sewer structures. If a manhole fails a leakage test the manhole must be made watertight and retested. Hydrostatic testing shall be conducted by plugging with Engineer approved plugs all influent and effluent pipes in the manhole and filling the manhole with water to the top of the manhole cone with water. Additional water may be added over a twenty-four (24) hour period to compensate for absorption and evaporate losses. At the conclusion of the twenty-four (24) hour saturation period the manhole shall be filled to the top of the manhole cone and observed. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Any loss within a thirty (30) minute period shall be considered an unsuccessful test. Vacuum testing shall be performed in accordance with the requirements of ASTM C-1244, Specification for Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.

3.05 SERVICE CONNECTIONS:

- A. Install service connections at each dwelling or business place, or as directed by Engineer.
- B. Services wyes: install wyes, 4-inch branch diameter unless shown otherwise on plans. See standard detail, "Typical Service Connection", Dwg. D-05.
- C. Risers: use in lieu of wyes for service connections where invert of sewer is 15 feet or more below ground surface or where shown on plans. See standard detail, "Typical Riser Service Connection".
- D. Place suitable stopper in end of connection, cement stopper in place with cold bituminous joint

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compound.

- E. Backfill trench only after recording exact location of service connection. Place engineer approved maker tape above service piping in excavation within 3-feet of the surface.
- F. Make no connections to house sewers or extend service connections beyond this contract without written permission of Engineer.
- G. Backfill trench only after entire service line and wye connection has been inspected and approved by Engineer. Compact as specified in Section 02221, "Trenching, Backfilling and Compacting".
- H. Street crossings shall have a minimum of 3 feet of cover to sub-grade unless approved by Engineer.
- I. No payment for service lines will be made until all specified requirements have been met.

3.06 CONNECTIONS TO EXISTING DRAINS AND SEWER SYSTEM

- A. Connect existing sanitary service drains which cross new sewer line through equal sized wye.
- B. Connect no storm drains to new sewers.
- C. Connections to existing manholes:
 - 1. Cut hole in existing manhole at required elevation.
 - 2. Insert new sewer pipe flush with inside of manhole.
 - 3. Grout new pipe in place.
 - 4. Reconstruct manhole bottom to suit new connection.
- D. Connections to existing sewer:
 - 1. Build new manhole around existing sewer.
 - 2. Break out existing sewer inside of manhole and construct bottom to suit new connection.

PART 4 - MEASUREMENT AND PAYMENT

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4.01 SANITARY SEWER PIPE

- A. Sanitary sewer pipe shall be measured from center of manhole to center of manhole or end of main. The sewer pipe shall be measured along the center of the pipe without considering fittings or other pipe connections. Sanitary sewer pipe will be paid at the contract bid price per linear feet complete in place at various depths for the type, size and depth constructed.
- B. Compensation will be for furnishing all materials, labor, equipment, tools and incidentals required by the construction of the sanitary sewer pipe, all in accordance with the plans and these specifications.
- C. If sanitary sewer pipe fails or does not pass appropriate mandrel test, Contractor shall remove and replace that part of the sewer pipe at no cost to the Owner.

4.02 SANITARY SEWER MANHOLE

- A. Sanitary sewer manhole will be measured from the top of the ground to the sanitary sewer invert. Manholes shall be paid at the contract bid price per each at the various depths.
- B. Compensation will be for furnishing all materials, labor, equipment, tools and incidentals required including any specified protective coating ring and cover, manhole insert, and/or A grade rings if not included as a separate pay item. All in accordance with the plans and specifications herein.

*** * * END OF SECTION * * ***

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SECTION 02577 - HOT MIX ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Hot mix asphalt concrete (HMAC) pavement shall consist of a binder course, a leveling up course, a surface course or a combination of the courses as shown on the plans, or as directed by the ENGINEER.
- B. HMAC pavement shall be composed of a compacted mixture of mineral aggregate and asphaltic material, constructed on previously completed and approved subgrade, subbase course, base course, or existing pavement.
- C. HMAC pavement shall be in accordance with the specifications herein and in conformity with the lines, grades, quantities and typical sections in the contract and/or as directed by the ENGINEER.

1.02 QUALITY CONTROL:

- A. HMAC pavement and its constituent part shall conform to the ASTM, AASHTO and/or TxDOT test methods noted below.

PART 2 - PRODUCTS

2.01 ASPHALTIC MATERIALS:

- A. Asphalt cement binders shall be uncracked petroleum asphalt and shall be carefully refined, by steam, vacuum, or solvent, from asphaltic or semi-asphaltic base crude petroleum at a temperature not to exceed 700° F. Asphalt cements shall be free from thermal decomposition products and shall not be blended with any materials which have been subjected to cracking or produced from a crude petroleum source other than that of the original material. The asphalt cement shall not contain residues from non-asphaltic sources. Asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347° F.
- B. Paving asphalt shall be classified by penetration or viscosity and shall conform to the requirements set forth in one of the following tables as designated by the ENGINEER. The

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CONTRACTOR may supply asphalt meeting the requirements of one of the following tables provided that he obtains prior approval of the ENGINEER and with the provision that once approval has been obtained, that the CONTRACTOR will remain with that grade throughout the project.

TABLE 2577-1

Specification Designation	AASHTO Test Method	ASTM Test Method	40 to 50	60 to 70	85 to 100	120 to 150	150 to 200	200 to 250
Flash Point (Open cup) Min	T48	D92	--	450	450	450	425	350
Penetration of Orig. Sample at 77° F	T49	D5	40 to 50	60 to 70	85 to 100	120 to 150	150 to 200	200 to 250
Thin-Film Oven Loss, Hours at 325° F, % Max	T179	D1754	0.75	0.75	0.75	0.75	1.00	1.00
Test of Residue from Thin-Film Oven Test: % of Orig. Pen., Min.	T49	D5	52	50	50	50	50	50
Ductility at 77°F cm. after loss at 325° F, Min.	T51	D113	50	50	100	100	100	100
Solubility in CCl ₄ 4 Min.	T44*	None	99.5	99.5	99.5	99.5	99.5	99.5

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Reaction to Spot Test	T102**	None	-0-	-0-	-0-	-0-	-0-	-0-
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* Procedure No. 1 with CCl₄ substituted for CS₂.

** Using 85% Standard Naphtha Solvent and 15% Xylene.

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TABLE 2577-2

TYPE-GRADE	OA-30		OA-175*8		OA-400	
	Min.	Max	Min.	Max	Min.	Max
Penetration at 32° F, 200g., 60 sec	15	--	--	--	--	--
Penetration at 77° F, 100g., 5 sec	25	35	150	200	--	--
Penetration at 115° F, 50g., 5 sec	--	65	--	--	--	--
Ductility at 77° F, 5 cm/min., cms: Original OA	2	--	70	--	--	--
Flash Point C.O.C., °F	450	--	425	--	425	--
Softening Point, R.&B., °F	185	--	95	130	--	--
Thin Film Oven Test, 1/8 in. Film 50 g., 5 hrs., 325° F, % Loss by wt.	--	0.4	--	1.4	--	2.0
Penetration of Residue, at 77° F, 100g., 5 sec. % of Original Pen	--	--	40	--	--	--
Ductility of Residue at 77° F, 5 cm/min., cms	--	--	--	100	--	--
Solubility in Trichloroethylene, %	99.0	--	99.0	--	99.0	--
Spot Test on Original OA	Neg.		Neg.		Neg.	
Float Test at 122° F, sec	--	--	--	120	150	
Test on 85 to 115 Pen.Residue* Residue by Wt., %	--	--	--	--	75	--

Ductility, 77° F, 5 cm/min:

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Original Res., cms	--	--	--	--	100	--
Subjected to Thin Film Test, cms	--	--	--	--	100	--

* Determined by Vacuum Distillation (by evaporation if unable to reduce by vacuum).

** For use with Latex Additive only.

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TABLE 2577-3

PROPERTIES	AC-1.5		AC-3		AC-5		AC-10		AC-20		AC-40	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Viscosity, 140° F. stokes. . . .	150	50	300	100	500	100	1000	200	2000	400	4000	800
Viscosity, 275° F. stokes. . . .	0.7	--	1.1	--	1.4	--	1.9	--	2.5	--	3.5	--
Penetration, 77° F. 100 g, 5 sec.	250	--	210	--	135	--	85	--	55	--	35	--
Flash Point, C.O.C.,°F.	425	--	425	--	425	--	450	--	450	--	450	--
Solubility in trichloroethylene, percent. . . .	99.0	--	99.0	--	99.0	--	99.0	--	99.0	--	99.0	--
Test on residues from thin film oven test: Viscosity, 140° F stokes. . . .	--	450	--	900	1500	--	3000	--	6000	--	--	12000
Ductility, 77° F, 5 cms per min,cms	100	--	100	--	100	--	70	--	50	--	30	--
Spot test	-----Negative for all grades-----											

- C. A minimum of two percent, by weight, latex additive (solids basis) shall be added to the OA-175 Asphalt or to AC-5 Asphalt when specified in the contract. The latex additive shall be governed by the following specifications:

The latex is to be an anionic emulsion of butadiene-styrene low-temperature copolymer in water, stabilized with fatty-acid soap so as to have good storage stability, and possessing the following properties:

Monomer ratio, B/S	70/30
Minimum solids content	67%
Solids content per gal.@ 67%	5.3 lbs.
Coagulum on 80-mesh screen	0.01% max.
Type Anti-oxidant	staining
Mooney viscosity of Polymer(M/L 4@212° F)	100 min.
pH of Latex	9.4 - 10.5
Surface tension	28-42 dynes/cm ²

The finished latex-asphalt blend shall meet the following requirements:

Viscosity at 140° F, stokes	1500 max.
Ductility at 39.2° F, 1 cm. per min., cm.	100 min.

D. Asphalt content shall be within the limits noted below:

Table 2577-4

HMAC Type	Percent of Mixture by Weight	Percent of Mixture by Volume
"A"	3.5 - 7.0	8.0 - 16.0
"B"	3.5 - 7.0	8.0 - 16.0
"C"	3.5 - 7.0	8.0 - 16.0
"D"	4.0 - 8.0	9.0 - 19.0
"F"	3.5 - 6.5	8.0 - 16.0

E. At the time of delivery of each shipment of asphalt, the vendor supplying the material shall deliver to the purchaser certified copies of the test report which shall indicate the name of the vendor, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, and results of the above-specified tests. The

test report shall be certified and signed by an authorized representative of the vendor that the product delivered conforms to the specifications for the type and grade indicated.

- F. Until the certified test reports and samples of the material have been checked by the ENGINEER to determine their conformity with the prescribed requirements, the material to which such report relates and any work in which it may have been incorporated as an integral component will be only tentatively accepted by the City. Final acceptance will be dependent upon the determination of the ENGINEER that the material involved fulfills the requirements prescribed therefor. The certified test reports and the testing required in connection with the reports will be at the expense to the City.
- G. Unless otherwise specified in these specifications or in the Supplementary Specifications, the various grades of paving asphalt shall be applied at a temperature range of from 210° F to 325° F, the exact temperature to be determined by the ENGINEER.
- H. Paving asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the paving asphalt during heating. The CONTRACTOR shall furnish and keep on the site, at all times, an accurate thermometer suitable for determining the temperature of the paving asphalt.
- I. HMAC asphalt shall be the grade having the highest penetration, within specified limits, to produce a mix having a maximum stability of the compacted mixtures.
- J. Only one (1) grade of asphalt shall be required unless otherwise shown on the plans or as required by the ENGINEER.

2.02 AGGREGATES:

- A. HMAC aggregate will be tested in accordance with the following test standards:

- AASHTO T-30 Mechanic Testing
- AASHTO T-27 Passing No. 200 Sieve
- AASHTO T-89 Liquid Limit
- AASHTO T-96 Los Angeles Abrasion
- AASHTO T-104 Soundness (Magnesium Sulfate)
- ASTM C – 131 Resistance to Degradation
- ASTM C – 136 Sieve Analysis
- ASTM C – 2419 Sand Equivalence Value
- TxDOT Tex -106-E Method of Calculating Plasticity Index of Solids
- TxDOT Tex-217 – F (I & II) Determination of Deleterious Materials and

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Decantation Test
TxDOT Tex-203 – F Quality Tests for Mineral Aggregates

- B. Aggregates shall have an abrasion of not more than 40 for all courses except the non-skid surface course, which shall have an abrasion of not more than 35.
- C. When properly proportioned, HMAC aggregate shall produce a gradation which will conform to the limitations for classification for HMAC type shown below, or as directed by the ENGINEER.
- D. Course aggregate to be crushed limestone rock or crushed gravel with hydrated lime or limestone filler. (Crushed gravel shall be per TxDOT Specifications.)
- E. Binder aggregate to be composed of 15% crushed limestone screening or as directed by the engineer.

1. Type "A" - Course Graded Base Course

	Percent Aggregate by Weight or Volume
Passing 2" sieve.....	100
Passing 1-3/4" sieve.....	95 to 100
Passing 1-3/4" sieve, retained on 7/8" sieve.....	16 to 42
Passing 7/8" sieve, retained on 3/8" sieve	16 to 42
Passing 3/8" sieve, retained on No. 4 sieve ..	10 to 26
Passing No. 4 sieve, retained on No. 10 sieve.....	5 to 21
Total retained on No. 10 sieve.....	68 to 84
Passing No. 10 sieve, retained on No. 40 sieve.....	5 to 21
Passing No. 40 sieve, retained on No. 80 sieve	3 to 16
Passing No. 80 sieve, retained on No. 200 sieve	2 to 16
Passing No. 200 sieve.....	1 to 8

2. Type "B" - Fine Graded or Leveling-Up Course

	Percent Aggregate by Weight or Volume
Passing 1" sieve.....	100
Passing 7/8" sieve.....	95 to 100
Passing 7/8" sieve, retained on 3/8" sieve	21 to 53
Passing 3/8" sieve, retained on No. 4 sieve.....	11 to 42
Passing No. 4 sieve, retained on No. 10 sieve.....	5 to 26
Total retained on No. 10 sieve.....	58 to 74

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Passing No. 10 sieve, retained on No. 40 sieve.....6 to 32
Passing No. 40 sieve, retained on No. 80 sieve.....4 to 21
Passing No. 80 sieve, retained on No. 200 sieve.....3 to 21
Passing No. 200 sieve.....1 to 8

3. Type "C" - Course Graded Surface Course

	Percent Aggregate by Weight or Volume
Passing 7/8" sieve.....	100
Passing 5/8" sieve.....	95 to 100
Passing 5/8" sieve, retained on 3/8" sieve	16 to 42
Passing 3/8" sieve, retained on No. 4 sieve.....	11 to 37
Passing No. 4 sieve, retained on No. 10 sieve.....	11 to 32
Total retained on No. 10 sieve.....	54 to 74
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 32
Passing No. 40 sieve, retained on No. 80 sieve.....	4 to 27
Passing No. 80 sieve, retained on No. 200 sieve.....	3 to 27
Passing No. 200 sieve.....	1 to 8

4. Type "D" - Fine Graded Surface Course

	Percent Aggregate by Weight or Volume
Passing 1/2" sieve.....	100
Passing 3/8" sieve.....	85 to 100
Passing 3/8" sieve, retained on No. 4 sieve.....	21 to 53
Passing No. 4 sieve, retained on No. 10 sieve.....	11 to 32
Total retained on No. 10 sieve.....	54 to 74
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 32
Passing No. 40 sieve, retained on No. 80 sieve.....	4 to 27
Passing No. 80 sieve, retained on No. 200 sieve.....	3 to 27
Passing No. 200 sieve.....	1 to 8

5. Type "F" - Fine Graded Surface Course

Percent Aggregate by

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	<u>Weight or Volume</u>
Passing 3/8" sieve.....	100
Passing No. 4 sieve.....	95 to 100
Passing No. 4 sieve, retained on No. 10 sieve.....	58 to 73
Passing No. 10 sieve, retained on No. 40 sieve.....	6 to 26
Passing No. 40 sieve, retained on No. 80 sieve.....	3 to 13
Passing No. 80 sieve, retained on No. 200 sieve.....	2 to 11
Passing No. 200 sieve.....	1 to 8

2.03 PRIME COAT:

- A. Prime coat, when specified on the plans, or directed by the ENGINEER, shall be in accordance with Section 02250 - Prime Coat, and as specified herein.
- B. Prime coat shall be applied to the surfaces of bases at least 12 hours prior to placing the HMAC unless otherwise directed by the ENGINEER.
- C. Asphalt prime shall be applied uniformly at the rate of 0.10 to 0.30 gallon per square yard, or as directed by the ENGINEER. It shall be applied only when permitted by the ENGINEER and when the air temperature is not less than 40°F.
- D. In order to prevent lapping at the junction of two applications, the distributor shall be promptly shut off. A hand spray shall be used to touch up all spots unavoidably missed by the distributor.
- E. Immediately prior to application of the asphalt prime, an inspection will be made by the ENGINEER to verify that the base course has been constructed as specified. Also, all loose and foreign material shall be removed by light sweeping. Material so removed shall not be mixed with cover aggregate.
- F. The surface to be primed shall be in a smooth and well-compacted condition, true to grade and cross section, and free from ruts and inequalities.
- G. The pressure distributor used for applying prime coat material shall be equipped with pneumatic tires and shall be so designed and operated as to distribute the prime material in a uniform spray without atomization, in the amount and between the limits of temperature specified. It shall be equipped with a speed tachometer registering feet per

minute and so located as to be visible to the truck driver to enable him to maintain the constant speed required for application at the specified rate.

- H. The pressure distributor shall be equipped with a tachometer registering the pump speed, pressure gauge, and a volume gauge. The rates of application shall not vary from the rates specified by the ENGINEER by more than 10%. Suitable means for accuracy indicating at all times the temperature of the prime material shall be provided. The thermometer well shall be so placed as not to be in contact with a heating tube.
- I. The distributor shall be so designed that the normal width of application shall be not less than 6 feet, with provisions for the application of lesser width when necessary. If provided with heating attachments, the distributor shall be so equipped and operated that the prime material shall be circulated or agitated through the entire heating process.
- J. The asphalt prime coat should preferably be entirely absorbed by the base course and, therefore, require no sand cover. If, however, it has not been completely absorbed prior to the start of placing the asphalt concrete mixture and in the meantime it is necessary to permit traffic thereon, sufficient sand shall be spread over the surface to blot up the excess liquid asphalt and prevent it from being picked up under traffic. Also, sand shall be used in areas where traffic may pass over the prime coat. Prior to placing the asphalt concrete, loose or excess sand shall be swept from the base. If a sand cover is specified in the Supplementary Specifications or noted on the plans to cover asphalt prime, it shall be applied within 4 hours after the application of said prime coat, unless otherwise ordered by the ENGINEER.
- K. Liquid asphalt shall be prevented from being sprayed upon adjacent pavements, structures, guard rails, guide posts, culvert markers, trees, and shrubbery that are not to be removed; adjacent property and improvements; other facilities or that portion of the traveled way being used by traffic.
- L. The CONTRACTOR shall protect the prime coat against all damage and markings, both from foot and vehicle traffic. Barricades shall be placed where necessary to protect the prime coat. If, after the prime coat has been applied to the satisfaction of the ENGINEER and has been accepted, if it is disturbed by negligence on the part of the CONTRACTOR, it shall be restored at his expense to its condition at the time of acceptance. No material shall be placed until the prime coat is in a condition satisfactory to the ENGINEER.

2.04 TACK COAT:

- A. If the asphalt concrete pavement is being constructed directly upon an existing hard-surfaced pavement, a tack coat shall be evenly and uniformly applied to the existing pavement prior to the placing of the new asphalt concrete. The surface shall be free of water, all-foreign material, or dust when the tack coat is applied. No greater area shall be treated in any one day than will be covered by the asphalt concrete during the same day. Traffic will not be permitted over tack coating.
- B. Tack coat for HMAC shall consist of either rapid curing cut-back asphalt RC-2 diluted by addition of (not to exceed 15 percent by volume) an approved grade of gasoline and/or kerosene; emulsified asphalt, EA-11M diluted with 50 percent water, or a cut-back asphalt made by combining 50 to 70 percent of the asphaltic materials specified for the paving mixture with 30 to 50 percent gasoline and/or kerosene by volume.
- C. Tack coat shall conform to the requirements of Section 2620 - Tack Coat, or as specified herein.
- D. Application rate shall be 0.10 to 0.15 gallons per square yard, or as directed by the ENGINEER.
- E. A similar tack coat shall be applied to the surface of any course if in the opinion of the ENGINEER, the surface is such that a satisfactory bond cannot be obtained between it and the succeeding course.
- F. When required, the contact surfaces of all cold pavement joints, curbs, gutters, manholes, and the like shall be painted with a tack coat immediately before the adjoining asphalt concrete is placed. Asphalt tack coat shall be applied in controlled amounts as shown on the plans or determined by the ENGINEER. Surfaces where a tack coat is required shall be cleaned to the satisfaction of the ENGINEER before the tack coat is applied.

2.05 MINERAL FILLER:

- A. Mineral filler, other than hydrated lime, shall consist of a thoroughly dry stone dust, portland cement or other mineral dust approved by the ENGINEER.
- B. The mineral filler shall be free from foreign or other deleterious matter.
- C. When tested by the method outlined in TxDOT Test Method Tex-200-F (Part 1 or 3), mineral filler shall meet the following gradations by weight:

Passing No. 30 Sieve	95-100%
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Passing No. 80 Sieve	75%
Passing No. 200 Sieve	55%

2.06 ANTI-STRIPPING COMPOUND

- A. Anti-Stripping compound, as required in the job mix formula, shall be furnished in the amounts calculated therein.

2.07 JOB MIX FORMULA:

- A. A job mix formula based on representative samples, including filler if required, shall be determined by the ENGINEER, or submitted by the CONTRACTOR for approval of the ENGINEER.
- B. The resultant job mix formula shall be within the master range for the specified type of HMA.
- C. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate and shall provide for 3 to 5% air voids in the resultant design mix. During the mix design process the ENGINEER will consider other factors, in addition to air voids and Marshall stability, such as durability, water resistance, and asphalt film thickness when developing the mix design.
- D. After the job mix formula is established, mixtures for the project shall conform to the following tolerances which may fall outside of the specified master range:

Percent by Weight or
Volume as Applicable

Passing 1-3/4" sieve, retained on 7/8" sieve	± 5
Passing 7/8" sieve, retained on 5/8" sieve	± 5
Passing 5/8" sieve, retained on 3/8" sieve	± 5
Passing 3/8" sieve, retained on No.4 sieve	± 5
Passing No.4 sieve, retained on No.10 sieve	± 5
Total retained on No.10 sieve	± 5
Passing No.10 sieve, retained on No.40 sieve	± 3
Passing No.40 sieve, retained on No.80 sieve	± 3
Passing No.80 sieve, retained on No.200 sieve	± 3

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Passing No.200 sieve

± 3

Asphaltic Material

± 0.05 by wt or 1.2 by vol.

Mixing Temperature

$\pm 20^{\circ}$ F

- E. Asphaltic mixture shall be tested in accordance with TxDOT Test Method Tex-200-4 (Part I or Part III) and shall have the following laboratory values:

		Surface Course	Base Course
Density:	Minimum	95%	95%
	Maximum	98%	99%
	Optimum	96.5%	96.5%
Stability (Hveem)			
	Minimum	30%	30%
	Maximum	45%	45%
Stability (Marshall – 75 Blow Briquette)		1500 lbs	1500 lbs.
Voids		3 - 7%	4 - 7%
Voids Filled With Asphalt		75 - 85%	65 - 80%
Sand Equivalent		40	40

2.08 EQUIPMENT:

- A. All equipment for the handling of all material, mixing, and placing of HMAC shall be in accordance with the provisions of TxDOT Item 340.

2.09 STOCKPILING, STORAGE, PROPORTIONING AND MIXING:

- A. Stockpiling, storage proportioning and mixing operations shall be in accordance with the Provisions of TxDOT Item 340.

PART 3 - EXECUTION

3.01 WEATHER AND TEMPERATURE LIMITATIONS:

- A. Asphaltic mixture, when placed with a spreading and finishing machine, or the tack coat shall not be placed when the air temperature is 50° F and falling, but may be placed when the air temperature is 40° F and rising.
- B. Asphaltic mixture, when placed with a motor grader, shall not be placed when the air temperature is 60° F and falling, but may be placed when the air temperature is 50° F and rising.
- C. Mat thicknesses of 1 inch or less shall not be placed when the temperature on which the mat is to be laid is below 50° F.
- D. No tack coat or asphaltic mixture shall be placed when the humidity, general weather conditions and temperature and moisture condition of the base, in the opinion of the ENGINEER, are unsuitable.
- E. If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is 50° F or more below the temperature established by the ENGINEER, all or any part of the load may be rejected and payment will not be made for the rejected material.

3.02 EQUIPMENT:

- A. Hauling Equipment:
 - 1. Trucks used for hauling asphaltic mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a minimal amount of paraffin oil, lime slurry, tene solution or other approved material to prevent mixture adhesion to the bed.
 - 2. The dispatching of hauling equipment shall be arranged so that all material delivered may be placed and all rolling completed during daylight hours, unless otherwise directed by the ENGINEER.
 - 3. All trucks shall be equipped with a cover of canvas, or other suitable material to protect the mixture from weather or on hauls where the temperature of the mixture

will fall below specified level. Use of covers will be as directed by the ENGINEER.

B. Rollers:

1. Pneumatic Tire Roller. This roller shall consist of not less than seven pneumatic tire wheels, running on axles in such manner that the rear group of tires shall cover the entire gap between adjacent tires of the forward group; mounted in a rigid frame; and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such manner that the roller may be turned within a minimum circle. The tire shall afford surface contact pressures up to 90 pounds per square inch or more. The roller shall be so constructed as to operate in both a forward and a reverse direction with suitable provisions for moistening the surface of the tires while operating; and shall be approved by the ENGINEER.
2. Two Axle Tandem Roller. This roller shall be an acceptable power-driven, steel-wheel, tandem roller weighing not less than eight tons. It must operate in forward and reverse directions; contain provision for moistening the surface of the wheels while in motion; and shall be approved by the ENGINEER.
3. Three Wheel Roller. This roller shall be an acceptable power-driven, all steel, three wheel roller weighing not less than 10 tons. It must operate in forward and reverse directions; contain provisions for moistening the surface of the wheel while in motion; and shall be approved by the ENGINEER.
4. Vibratory Steel Wheel Roller. If approved for use by the OWNER, this roller shall have a minimum weight of six tons. The compactor shall be equipped with amplitude and frequency controls and shall be specifically designed to compact the material on which it is used. It shall be operated in accordance with the manufacturer's recommendations.

C. Straight Edges:

1. The CONTRACTOR shall provide an acceptable 16-foot straight-edge for surface testing. Satisfactory templates shall be provided as required by the ENGINEER.

D. Spreading and Finishing Machine:

1. Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or a strike-off assembly, heated if necessary, and capable of

spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the plans.

2. The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. Design will be such that no part of the truck weight will be supported by the paver.
3. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture. The screed shall be adjustable for both height and crown and shall be equipped with a controlled heating device.
4. The bituminous paver shall be equipped with an automatic leveling device controlled from an external guide. The initial pass for each course shall be made using a paver equipped with a 40-foot minimum external reference, except that these requirements will not apply when asphalt concrete is placed adjacent to portland cement concrete pavement. Subsequent passes may utilize the matching device of one foot minimum length riding on the adjacent lay.

3.03 CONSTRUCTION METHODS:

A. Spreading and Finishing:

1. The asphalt concrete mixture shall be laid on the approved surface, spread and struck off to the grade and elevation established. It shall be spread and compacted in layers as shown on the plans or as directed by the ENGINEER. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.
2. The ENGINEER will determine a minimum placement temperature within a range from 220° F to 300° F which will produce the required density. The established placement temperature, which is measured immediately behind the laydown machine, shall not vary more than 20° F.
3. A conventional paver or suitable equipment approved by the ENGINEER may be used to place asphalt concrete material on shoulders depressed from the traveled

lanes in order to establish a uniform typical section. Approval of the equipment used will be based upon the results obtained.

4. The asphalt concrete may be dumped from the hauling vehicles directly into the paving machine or it may be dumped upon the surface being paved and subsequently loaded into the paving machine; however, no asphaltic concrete shall be dumped from the hauling vehicles at a distance greater than 250 feet in front of the paving machine. When asphaltic concrete is dumped first upon the surface being paved, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphaltic concrete dumped shall be picked up and loaded into the paving machine.
5. To achieve, as far as practicable, a continuous operation, the speed of the paving machine shall be coordinated with the production of the plant. Sufficient hauling equipment shall be available to insure continuous operation.
6. The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other indirectly either through controlling the transverse slope or alternately when directed, by controlling the elevation of each end independently, including any screed attachment used for widening, etc. Failure of the control system to function properly shall be cause for the suspension of the asphaltic concrete operations.
7. When dumping directly into the paving machine from trucks, care shall be taken to avoid jarring the machine or moving it out of alignment.
8. All courses of asphaltic concrete shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the ENGINEER deems the use of self-propelled, paving machines impracticable.
9. Self-propelled paving machines shall spread the asphaltic concrete without segregation or tearing within the specified tolerances, true to the line, grade, and crown indicated on the plans. Pavers shall be equipped with hoppers and augers which will place the asphaltic concrete evenly in front of adjustable screeds without segregation. Screeds shall include any strike-off device operated by tamping or vibrating action which is effective without tearing, shoving or gouging the asphaltic concrete and which produces a finished surface of an even and uniform texture for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required.

10. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, fluted and compacted with hand tools. For such areas the mixture shall be dumped, spread and screed to give the required compacted thickness.

B. Compaction:

1. Rolling with the 3-wheel and tandem roller shall start longitudinally at the sides and proceed toward the center of the surface course, overlapping on successive trips by at least half the width of the rear wheels.
2. Alternate trips of the roller shall be slightly different in length.
3. Rolling with a pneumatic tired roller shall be as directed by the ENGINEER.
4. Rolling shall continue with no further compression can be obtained and all roller marks are eliminated.
5. The motion of the roller shall be slow enough at all times to avoid displacement of asphaltic materials. If displacement occurs, it shall be corrected immediately by use of rakes and fresh asphaltic mixtures, where required.
6. The roller shall not be allowed to stand on the surface course when it has not been fully compacted and allowed to cool.
7. To prevent adhesion of the surface course to the roller, the wheels shall be kept thoroughly moistened with water; however, excess water shall not be allowed.
8. All precautions shall be taken to prevent dripping of gasoline, oil, grease, or other foreign substances on the surface or base courses during rolling operations or while rollers are standing.
9. With the approval of the ENGINEER, a vibratory steel wheeled roller may be substituted for the 3-wheel roller and tandem roller.
10. Along forms, curbs, headers, walls and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or with mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

11. Any mixture that becomes loose, broken, mixed with dirt, segregated, or is in any way defective shall be removed and replaced with fresh hot bituminous mixture, which shall be compacted to conform to the surrounding area. Any area showing excess or deficiency of bituminous material shall be corrected immediately as directed by the ENGINEER.

C. In-Place Density:

1. In-place density shall be required for all mixtures except thin irregular depth leveling courses.
2. Each course, after final compaction, shall have a density of not less than 95 percent of the density developed in the laboratory test method outlined in TxDOT Bulletin C-14.
3. Density shall be determined with a portable nuclear test device in conformity with ASTM D-2950.76.
4. Calibration of the portable nuclear device will be established by the ENGINEER from cut pavement samples tested in accordance with AASHTO T-166 (weight, volume method). The density readings of the cut pavement samples determined in accordance with AASHTO T-166 (weight, volume method), and the density readings of the pavement samples determined by the portable nuclear test device in conformity with ASTM D 2950 will be correlated by the ENGINEER.
5. Other methods of determining in-place density may be used as deemed necessary by the ENGINEER.
6. It is intended that acceptance density testing will be done while the bituminous mixture is hot enough to permit further compaction if necessary. If the density of an acceptance section does not meet the specified requirements, the CONTRACTOR shall continue the compaction effort until the optimum density is obtained. Rolling for any compactive effort will not be allowed when the temperature of the mix is below 175° F unless authorized in writing by the ENGINEER. Rerolling the paved surface after it has initially cooled will not be allowed.
7. If in-place density tests of the mixture produce a value lower than specified and in the opinion of the ENGINEER is not due to a change in the quality of the material, production may proceed with subsequent changes in the mix and/or construction procedures until in-place density equals or exceeds the specified density.
8. In-place density tests will be provided by the ENGINEER unless otherwise specified.

D. Joints:

1. Placing of the asphalt concrete shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the ENGINEER.
2. When plant mix bituminous pavement is placed over plant mix bituminous treated base or when plant mixed seal coat is placed over plant mix bituminous pavement, longitudinal joints shall be staggered at least 6 inches with relation to the longitudinal joints of the underlying course.
3. Transverse joints shall have a two foot or 12:1 minimum taper. Longitudinal joints shall have a one foot or 6:1 minimum taper. All transverse tapers shall be cut and squared off prior to commencing new work. Tapered longitudinal joints from previous operations shall be cleaned and tack coated if directed by the ENGINEER. All joints shall be completely bonded. The surface of each course at all joints shall be smooth and shall not show any deviations in excess of 3/16 of an inch when tested with a 10-foot straightedge in any direction.
4. When paving under traffic, the CONTRACTOR shall plan his daily surfacing operations on a schedule which will result in not more than one (1) day's operation of exposed longitudinal joints. The longitudinal joints shall not have a height greater than two (2) inches and shall not be left exposed longer than 24 hours.

E. Surface Tolerance:

1. Upon completion, the pavement shall be true to grade and cross section.
Except at intersections or any changes of grade, when a 16 foot straight edge is laid on the finished surface parallel to the centerline of the roadway, the surface shall not vary from the edge of the straight edge more than 1/16-inch per foot. Areas that are not within this tolerance shall be brought to grade immediately following the initial rolling. After the completion of final rolling, the smoothness of the course shall be checked, and the irregularities that exceed the specified tolerances or that retain water on the surface shall be corrected by removing the defective work and replacing with new material as directed by the ENGINEER at the expense of the CONTRACTOR.

F. Manholes and Valve Covers:

1. Manhole frames and valve covers shall be adjusted prior to placing the surface course.

G. Compacted Thickness of HMAC Surface and Base Courses:

1. Surface Courses. The compacted thickness or depth of the asphaltic concrete surface course shall be as shown on the plans. Where the plans require a depth or thickness of the surface course greater than two inches compacted depth, same shall be placed in multiple courses of equal depth, each of which shall not exceed two inches compacted depth. If, in the opinion of the ENGINEER, an additional tack coat is considered necessary between any of the multiple courses, it shall be applied at the rate as directed.
2. Base Courses. The compacted thickness or depth of each base course shall be as shown on the plans. Where the plans require a depth or thickness of the course greater than 4 inches, same shall be accomplished by constructing multiple lifts of approximately equal depth, each of which shall not exceed these maximum compacted depths. If, in the opinion of the ENGINEER, an additional tack coat is considered necessary between any of the multiple lifts, it shall be applied as hereinbefore specified and at the rate as directed.

H. Pavement Thickness Tests:

1. Pavement Thickness Test. Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the ENGINEER or his authorized representative unless otherwise specified in the special provisions or in the plans. The number and location of tests shall be at the discretion of the OWNER. The cost for the initial pavement thickness test shall be at the expense of the ENGINEER. In the event a deficiency in the thickness of pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the CONTRACTOR's expense.

I. Price Adjustment for Roadway Density

1. The payment of the unit price will be adjusted for roadway density as outlined in the following table. The adjustment will be applied on a lot by lot basis for each lift. The adjustment will be based on the average of five density tests. The price adjustment will be applied to the entire asphalt concrete mix which includes the HMAC aggregate, the asphalt cement and anti-stripping compound, if used.
- 2.

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Average Density % of Lab Density	Percent of Contract Price To Be Paid
Above 95%	100%
94.0 to 94.99	96%
93.0 to 93.99	91%
92.0 to 92.99	85%
Less than 92.00	*

* This lot shall be removed and replaced to meet specification requirements as ordered by the ENGINEER. In lieu thereof, the CONTRACTOR and the ENGINEER may agree in writing that for practical purposes, the lot shall not be removed and will be paid for at 50% of the contract price.

PART 4 - MEASUREMENT AND PAYMENT

4.01 INCIDENTAL WORK:

- A. Prime coat, anti-stripping compound, where used, and tack coat shall not be measured for direct payment, but shall be considered as subsidiary work pertaining to the placing of asphaltic mixtures of the contract price.

4.02 MEASUREMENT:

- A. Hot-mix asphalt concrete material shall be measured by the ton of 2,000 pounds or by the square yard of the type or types used in the completed and accepted work, as shown on the HMA Solicitation Bid Sheet.
- B. Weight shall be determined by a certified scale approved by the OWNER and recorded serially numbered weight tickets, identifying the vehicle and presented to the ENGINEER's representative on the job.

4.03 PAYMENT:

- A. Work performed and materials furnished, as prescribed by this item, measured as provided herein, shall be paid at the unit bid price per ton or square yard for the type or types of hot mix asphalt concrete pavement shown on the proposal.

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- B. Unit bid price shall be payment in full for quarrying; furnishing all materials; for all heating; mixing; hauling; cleaning existing base course or pavement; placing asphaltic mixtures; rolling and finishing; and for all labor, tools, equipment and incidentals necessary to complete the work, including the work and materials involved in the application of prime coat and tack coat.

*** * * END OF SECTION * * ***

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SECTION 02580 - STORM SEWER APPURTENANCES

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of furnishing and installing appurtenances except manholes, for storm sewers in accordance with details on the plans and as specified herein as directed by the ENGINEER.
- B. The various types of structures and appurtenances such as inlets, headwalls, energy dissipators, etc. are designated on the plans by letters or by numbers indicating the particular design of each. Each type shall be constructed in accordance with the details indicated and to the depth required by the profiles and schedules given.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. The construction plans will specify the size and material for the pipe between the storm sewer main and the storm water collection structure.
- B. The various types of storm inlets and their relation to curb and gutter, or valley gutter are shown on the Standard Detail Drawings. Construction plans will identify the type to be constructed.
- C. Grating size, material, and configuration shall conform to the Standard Detail Drawings.

2.02 MATERIALS:

- A. Concrete
 - 1. Concrete for cast in place miscellaneous structures shall be Class A concrete when used with precast pipe sewer construction and Class C concrete when used with monolithic pipe sewer construction.
 - 2. Concrete for precast structures shall be 4000 psi and comply with the applicable requirements of ASTM C 478.
- B. Mortar:

1. Mortar shall be composed of 1 part Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions of Section 03300 for fine aggregate.
2. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

C. Reinforcement:

Reinforcing Steel shall conform to Section 03330.

D. Brick:

1. Bricks shall be of first quality, sound, hard-burned brick. Shale bricks, if used, shall be homogeneous, thoroughly and uniformly burned.
2. Bricks shall not absorb more than 17 percent of water by weight submerged in water for 24 hours, having been in a completely dry state prior to placing in water.
3. Clay brick shall conform to the requirements of ASTM C 62, Grade SW. concrete brick meeting the requirements of ASTM C 55, Grade A, shall be acceptable.

E. Concrete Block:

Concrete blocks when indicated shall conform to ASTM C 139.

F. Frames, Grates, Rings and Covers:

Frames, grates, rings and covers shall conform to Section 02571.

G. Miscellaneous Items:

Cast iron for supports, steps and inlet units shall conform to the shape and dimensions indicated. The casting shall be clean and perfect, free from sand or blow holes or other defects. Cast iron casting shall meet the requirements of ASTM A 48, Class 30. Steel for temporary covers when used with Stage Construction shall be adequate for the loads imposed.

PART 3 - EXECUTION**3.01 INSTALLATION OF DRAINAGE FACILITIES:**

- A. Trenching, backfilling, and compaction for the connecting pipe between the storm sewer main and the storm inlet shall conform to the specifications contained in Section 02221. Pipe shall be installed in accordance with Section 02571.
- B. All pipe and structures shall be installed per location and elevations, as shown on the construction plans. If during the course of installation, an underground obstruction (i.e., existing utility line) the work shall stop and the ENGINEER shall be immediately notified so that the problem can be resolved.
- C. Direct connection to storm sewer main will be permitted if the main is a minimum of 36 inches in diameter (I.D.) and the connecting line is not greater than 12-inches (I.D.). If storm sewer mains are 48 inches (I.D.) or larger, the connecting line diameter may be increased to 18 inches (I.D.). For connecting line sized greater than those specified above, the connecting to the main will be made into a manhole or by inserting into the main a factory constructed wye. Connection to the main will comply with the Standard Detail Drawings.
- D. Removal of curb and gutter, and sidewalk for installation of a storm inlet shall be made at a scored or full depth joint.
- E. No width greater than 1/2 inch will be permitted between the inlet grate and the roadside portion of the inlet frame.
- F. Private drainage facility installations, which are to be constructed under the authorization of "Drainage Facilities within Public Right-of-Way," shall comply with the Standard Detail Drawings and appropriate sections of this publication.
- G. The construction inlets shall be done as soon as is practicable after sewer lines into the inlet are complete. All sewers shall be cut neatly at the inside face of the walls of the inlet and pointed up with mortar.
- H. Bases for cast in place inlets may be placed prior to or at the CONTRACTOR'S option after the sewer is constructed.

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- I. The inverts passing out or through an inlet shall be shaped and grout across the floor of the inlet as indicated. This shaping may be accomplished by adding shaping mortar or concrete after the base is cast or by placing the required additional material with the base.
- J. All miscellaneous structures shall be completed in accordance with the details indicated. Backfilling to original ground elevation shall be in accordance with the provisions of the appropriate items and as directed by the ENGINEER.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Pavement removal and replacement will be measured by the square yard.
- B. Trenching, backfilling and compaction will not be measured or paid, but will be considered incidental to other items.
- C. Frame, grates, rings and covers will not measured or paid, but will be considered incidental to other items.
- D. Connecting pipe shall be measured by the linear foot along centerline of pipe from the main side wall of the inlet to the centerline of the main.
- E. Storm sewer inlets shall be measured per each for the type and size specified.
- F. All miscellaneous structures satisfactorily completed in accordance with the plan and specifications will be measured as complete units per each.

4.02 PAYMENT:

- A. The accepted quantities of pavement removal and replacement shall be paid for at the unit bid price per square yard per type of replacement paving material.
- B. The accepted quantities of connecting pipe shall be paid at the unit bid price per linear foot per type and size of pipe, and shall include pipe in place and all necessary jointing materials.
- C. The accepted quantities of storm inlets will be paid at the unit price per each per type of storm inlet, and shall include: structure, grating, excavation, backfilling and compaction, and curb removal and replacement.

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- D. The accepted quantities of special complete structures shall be paid at the unit bid price per each.
- E. Compensation, whether by contract pay item or incidental work will be for furnishing all material, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

*** * * END OF SECTION * * ***

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SECTION 02660 - WATER LINES

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2241	(1988) Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
ASTM D 2564	(1988) Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B301	(1987) Liquid Chlorine.
AWWA C110	(1987) Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids.
AWWA C500	(1986) Gate Valves for Water and Sewage Systems.
AWWA C651	(1986) Disinfecting Water Mains.
AWWA C900 through 12 In. for Water.	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In.

1.1.1 Piping for Water Distribution Lines 3 Inches or Larger

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Piping for water distribution lines 3 inches or larger shall be ductile iron, Polyvinyl Chloride (PVC) plastic, or reinforced concrete, unless otherwise shown or specified.

1.1.2 Excavation, Trenching, and Backfilling for Water Lines

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02221 TRENCH EXCAVATION, BACKFILL AND COMPACTION, except as modified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

Materials shall conform to the respective specifications and other requirements specified below.

2.1.1 Pipe

2.1.1.1 Polyvinyl Chloride (PVC) Plastic Pipe

- a. Pipe 4-Inch through 12-Inch Diameter: Pipe, couplings and fittings 4-inch through 12-inch diameter shall conform to the requirements of AWWA C900, Class 150, CIOD pipe dimensions only, elastomeric-gasket joint only, unless otherwise shown or specified.
- b. For pipe 4-inch through 12-inch diameter, fittings and specials shall be cast iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with the requirements of AWWA C900. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

2.1.2 Valves

2.1.2.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning

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counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.1.2.2 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.3 Valve Boxes

Valve boxes shall be cast iron. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16-inch. The word "WATER" shall be cast in the cover. The boxes shall be of such length as will be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

2.1.4 Fire Hydrants (See Detail Sheet)

2.1.4.1 Disinfection

Chlorinating materials shall conform to the following: Chlorine, Liquid: AWWA B301.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Water shall be kept out of the trench until joining is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his

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expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored.

3.1.1.1 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions.

3.2 HYDROSTATIC TESTS

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Joints showing visible leakage shall be replaced. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 200 psi pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = 0.0001351 N D (P \text{ raised to } 1/2 \text{ power})$$

In which L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in psi gauge.

3.3 DISINFECTION

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651.

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End of Section

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SECTION 02665 - WATER SYSTEMS

PART I - GENERAL

1.01 SECTION INCLUDES:

- A. Water mains including valves, valve boxes, fire hydrants, blocking, fittings and other appurtenances.

1.02 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D1 784 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 2. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SOR-PR).
 - 3. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- B. American Water Works Association (AWWA):
 - 1. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
 - 2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches
 - 3. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds
 - 4. AWWA C 1 53 - Ductile Iron Compact Fittings, 3 inches through 16 inches
 - 5. AWWA C502 - Dry-Barrel Fire Hydrants.
 - 6. AWWA C509 - Resilient Seated Gate Valves, for Water and Sewerage Systems.
 - 7. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
 - 8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water.

1.03 SUBMITTALS:

- A. Product Data: Manufacturer's product data sheets on fire hydrants, valves, and valve boxes.

1.04 PROJECT CONDITIONS:

- A. Perform no pipe work in fill areas until embankment or fill has been completed to at least 2 ft. above top of pipe and has been properly compacted.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE:

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- A. PVC Water Pipe (4-inch through 12-inch): AWWA C900, pressure class 150.
- B. PVC Water Pipe (smaller than 4-inch): ASTM D1784 and ASTM D1785 or ASTM D2241.
- C. PVC water pipe shall bear NSF seal of approval and shall have a minimum water pressure rating of 200 psi.

2.02 DUCTILE IRON PIPE:

- A. Type: AWWA C151 , Class 52.
- B. Wrapping: Buried pipe wrapped with 8 mil polyethylene encasement, AWWA C105.

2.03 FITTINGS:

- A. Buried Fittings (size 4-inch through 12-inch): Ductile iron compact type with push-on joints, ANSI A21.53/AWWA C153, or standard fittings, AWWA C110. Use mechanical joints with retainer glands where required for complete system.
- B. Buried Fittings (smaller than 4 inches): Schedule 40 PVC, ASTM D2466, NSF approved and sealed or marked for potable water use.
- C. Rating: Fittings working pressure rated to 250 psi.
- D. Wrapping: Buried ductile iron fittings wrapped with 8-mil polyethylene encasement, AWWA C105.

2.04 GATE VALVES:

- A. Gate Valves 4-inch through 12-Inch Size for Buried Service.
 - 1. Type: Solid wedge, resilient seat type.
 - 2. Standard: Except as otherwise specified, AWWA C509.
 - 3. Working Pressure: Rated to 250 psi minimum.
 - 4. Stem: Non-rising stem with O-ring valve packing and 2-inch square nut.
 - 5. Joints: Push-on joints except as specified otherwise.
 - 6. Opening: Counterclockwise.
 - 7. Finish: Ferrous surfaces of valve interior epoxy coated, AWWA C550.
 - 8. Wrapping: Wrap valve body with 8 mil polyethylene encasement in a manner which will not interfere with valve operation.

2.05 FIRE HYDRANTS:

- A. Quality: AWWA C502, and as modified by these Specifications.
- B. Type: Compression-type shutoff closing with pressure, collision safety construction and dry top

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designed for 250 psi working pressure. Fabricate working parts from bronze.

C. Equip barrel with a bronze 6-inch inlet connection having a self-centering drain valve. Provide connection with two 2-1/2 inch inside diameter hose nozzles and a 4-1/2 inch connection. Use National Standard threads at connections.

D. Equip nozzles with nozzle caps securely fit and with cap gaskets of rubber. Other hydrant gaskets may be of rubber composition, lead or impregnated fiber composition. Attach nozzle caps to the barrel with chains not less than 1/8-inch diameter.

E. Provide a hydrant with bury length (the distance from the bottom of inlet line to ground line) as shown on Drawings.

F. Design barrel joint connecting upper and lower hydrant sections so that hydrant shutoff valve will remain closed and reasonably tight against leakage in the event of an impact resulting in damage or breaking of hydrant above or near ground level. Provide the joint with a breakable bolt flange or breakable coupling that will include a minimum of eight bolts. Provide valve stem with a breakable stem coupling opposite breakaway barrel.

G. Provide valve stem with a bronze sleeve and suitable seals and a travel stop. Do not expose operating threads to water. Lubricate threads fully when opening and closing shutoff valve from lubricating reservoir sealed top and bottom. Equip valve stem with a thrust bearing or lubricated thrust collar to minimize operating torque.

H. Furnish a valve stem which opens counterclockwise.

I. Provide a valve stem operating nut that is nonrising, pentagonal shape, with 1-1/2 inch from point to flat and depth of 1-1/4 inch.

J. Operating parts, including valve seat, shall be removable through barrel, without digging.

K. Paint fire hydrants with one coat of red oxide primer and two finishing coats of alkyd paint red color for barrels and white color for bonnet.

2.06 VALVE BOXES:

- A. Qualities: Cast iron valve boxes for buried valves, 2-section adjustable screw type, suitable for depth of cover over pipe as shown, with base, top section and cover.
1. Size: At least 5 inches in diameter, 3/16 inch thick, with suitable cast iron bases and covers.
 2. Coatings: Coat valve boxes, bases and covers by dipping in hot bituminous varnish.
 3. Cover: Locking type covers. Identify covers with casting, WATER.

B. Source: Mueller H-10360.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Staking of waterline shall be provided by owner.
- B. Prior to installing valves or fire hydrants, remove foreign matter from within the valves. Inspect the valves in open and close position to verify that parts are in satisfactory working condition.
- C. All pipe materials and installation procedures shall conform to the requirements of Texas Natural Resource Conservation Commission (TNRCC).

3.02 SETTING VALVES, VALVE BOXES AND FIRE HYDRANTS:

- A. Install valves, valve boxes and fire hydrants where shown on Drawings. Set valves and fire hydrants plumb and as detailed on Drawings. Center valve boxes on valves. Locate valves away from roads or streets. Carefully tamp earth around each valve box for a minimum radius of 4 feet or to undisturbed trench face if less than 4 feet.
- B. Place a concrete thrust block opposite pipe connections, set against vertical face of trench to prevent hydrant from blowing off line. If character of soil is such that fire hydrant cannot be securely wedged in this manner, provide bridle rods and rod collars of not less than 3/4 inch stock protected by a coat of acid-resisting paint.
- C. Place at least 5 cubic feet of gravel or crushed stone around base of fire hydrant to ensure drainage. Do not block drain holes. Compact backfill thoroughly around hydrant to grade line.

3.03 PIPE INSTALLATION:

- A. Preparation:
 - 1. Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to top of pipe. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substance will enter pipes or fittings.
 - 2. Keep inside of pipe free from foreign matter during operations by plugging or other approved method.
 - 3. Place pipe so that full length of each section rests solidly upon pipe bed, with recesses excavated to accommodate bells and joints. Take up and relay pipe when grade or joint is disturbed after laying.
 - 4. Locate no joints closer than 9 feet from sanitary sewer cross-overs.

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5. Where pipe ends are left for future connections, install valves, plugs or caps and thrust blocking, as shown.
6. Handle pipe and accessories so that pipe placed in trench is sound and undamaged. Take particular care not to injure pipe coating when applicable. Do not place other pipe or anything else inside of pipe or fitting after coating has been applied.
7. Cut neatly, using approved type mechanical cutter without damaging pipe. Use wheel cutters when practicable.
8. Before installation, inspect pipe for defects and tap with a light hammer to detect cracks. Replace sections of pipe found to be defective, damaged or unsound, before or after laying.
9. Wrap ductile iron pipe, fittings and accessories with 8 mil polyethylene film, AWWA C105, with edges overlapped and securely taped with duct tape to prevent contact between pipe and surrounding bedding. Repair punctures with duct tape to restore the protective continuous wrap before backfilling.

B. Pipe Bedding and Backfill: See Typical Detail Sheets

C. Placing and Laying:

1. Bury water lines and fire hydrants leads as shown on Drawings.
2. Do not exceed pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, furnish special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits set or approved.

D. Joints:

1. Install mechanical joints in accordance with manufacturer's recommendations.
2. Make push-on joints in accordance with manufacturer's recommendations.

E. Anchorage of Fittings - Thrust Block: Anchor tees, bends and plugged, valved or capped ends of lines of water mains with concrete thrust blocks as necessary and as shown on Drawings. Place blocks so that the joints will be accessible for inspection and repair.

3.04 SERVICE CONNECTIONS:

A. Provide water service leads and include corporation and meter stops and meter vault installed as shown.

B. Service Connections:

1. One inch and smaller: Corporation stops. Only AWWA threads will be allowed.
2. Up to 2 inches: Service clamps. Furnish a malleable iron galvanized service clamp with 250 psi working pressure and include a neoprene gasket cemented in place.
3. Larger than 2 inches: Pipe fittings.

C. Make service connections in accordance with manufacturers recommendations.

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- D. Connections shall be located no closer than one foot from fitting or pipe joint.

3.05 STERILIZATION:

- A. After completion of hydrostatic tests, flush and sterilize water mains in accordance with TNRCC AWWA C651 , utilizing chlorinating and procedures reviewed by Engineer.
 - 1. Disinfect the water distribution system using chlorine or chlorine compounds added to the water resulting in 25 ppm (parts per million) chlorine.
 - 2. After the water containing this amount of chlorine has been in contact with the pipe and appurtenances at least 24 hours, replace the chlorine treated water with water to be transported normally.
- B. Before beginning sterilization, remove dirt and foreign matter from water mains by a thorough flushing with clean water.
- C. Provide erosion control devices necessary to prevent soil erosion as a result of flushing or draining water lines.

3.06 FIELD QUALITY CONTROL TESTING:

- A. Perform hydrostatic tests and bacteriological tests on new water lines and lowered/relocated water lines.
- B. Hydrostatic Tests:
 - 1. General:
 - a. After pipe has been laid and initial backfill and blocking completed, test water lines hydrostatically to a test pressure of 150 psi. Achieve test pressure with compressed air.
 - b. Provide connections, pumps, gauges, meters and other equipment necessary for performance of tests.
 - 2. Procedures:
 - a. Before applying specified pressure test, expel all air from the pipe by filling each valved section of pipe with water. Provide taps necessary to expel trapped air.
 - b. Examine all piping, flings, valves and joints during testing. Fully operate each valve in the test section during testing.
 - c. Test each section for a minimum of 2 hours when joints are exposed, 8 hours when joints are covered.
 - d. Test pipe lines in lengths between valves or plugs of not more than 1000 feet
- 3. Maximum Allowable Leakage: Not to exceed 12 gallons per inch of pipe diameter per mile of pipe per 24 hours, except replace joints regardless of total leakage quantity where visible leaks occur at exposed joints and where leaks are evident at the surface of joints that are covered.

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4. Replace defective material with sound material, and repeat test procedures until approved is obtained.
- C. Bacteriological Tests: After sterilizing and flushing mains, obtain services of an approved laboratory to gather representative samples and conduct bacteriological tests in accordance with AWWA C651. Test results shall meet TNRCC. Make necessary corrections, repeat sterilization and flushing procedures, and retest affected lines if test results are not acceptable. Repeat this procedure until satisfactory test results are obtained.

END OF SECTION

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SECTION 02720 STORM SEWER

PART I - GENERAL

1.01 SECTION INCLUDES:

- A. Material and installation of storm sewer pipe and appurtenances, including headwalls.

1.02 RELATED SECTIONS:

- A. Section 02221 – EXCAVATION, TRENCHING, AND BACKFILLING AND COMPACTION

1.03 REFERENCES:

- A. ASTM C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
- B. Texas Department of Transportation (TXDOT) 2004 Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges.

1.04 SUBMITTALS:

- A. Pipe Certification: Manufacture's certification that pipe meets the requirements of these specifications.

PART 2 - PRODUCTS

2.01 STORM SEWER PIPE:

- A. Reinforced Concrete Pipe: Provide reinforced concrete pipe which conforms with ASTM C76, Class III

2.02 CONCRETE PIPE JOINT MATERIAL:.

- A. Cold Compound Joints: For concrete pipe sections carrying rainfall runoff, furnish pipe joint material (Talcote No. 0.52, Gulf States No. GS 702, or Ram-Nek flexible) plastic gasket manufactured by the K. T. Snyder Company, Inc.) meeting the requirements of the TxDOT Standard Specification for Construction and Maintenance of Highways, Streets and Bridges, Item 464.2 paragraph I.2. Apply a primer of the type recommended by the manufacturer of the compound used.

PART 3 – EXECUTION**3.01 EXCAVATION, BACKFILLING AND COMPACTION:**

- A. Trenching and backfilling shall be in accordance with Section 02221 and details.

3.02 PIPE INSTALLATION:

- A. Pipe Sewers and Culverts: Do not place pipe until the excavation has been completed, the bottom of the trench shaped, proper bedding material placed, and the line and grade have been obtained. Lay pipe accurately to line and grade in a straight line with spigot or tongue end of the pipe pointing in the direction of flow. Layout pipes together and match them so that when laid, the pipe will form a sewer or culvert with a smooth and uniform invert except where there is a pipe size change, in which case, the crowns of the larger and smaller pipes shall be at the same elevation and a concrete collar used to make the connection, unless otherwise shown.

3.03 CONCRETE PIPE CULVERT JOINT INSTALLATION:

- A. Cold Compound Joints.
1. Tongue and Groove Pipe. Completely coat both ends of the pipe with primer. Coat pipe only when the pipe is clean and dry. Allow the primer to dry before the pipe is laid. Pipe 24 inches and larger must be primed at the factory. After pipe has been set to proper line and grade in the trench, trowel or otherwise apply to the groove end of the pipe a 1/2-inch-thick layer of compound. Cover two-thirds of the joint face around the entire circumference. Next shove home the tongue end of the next pipe with sufficient pressure to make a tight joint. Take care to avoid leaving ridges of compound projecting into the pipe. Make necessary adjustments in the quality, and consistency of the compound, as directed by the Owner.
 2. Positioning. Joints made with cold compound may be pulled home by means of a suitable winch or other suitable power equipment or a come-along. Do not use a bar stuck into the ground for positioning joints on pipe larger than 10 inches. A bar may be used to push home the joints in pipe 10 inches and smaller, provided the joints are pushed all the way home. Positioning joints multiplied by the laying length per joint must equal the actual length of sewer in any given section. Pull pipe home in a straight line with all parts of the pipe on line and grade. Do not permit horizontal or vertical movement of the pipe during or after the pulling operation. Pull or push home rubber gasket joints by any suitable means that will provide adequate pressure to ensure proper assembly of the joint. Use special care to ensure that the joints are positioned in accordance with the published instructions of the manufacturer. Do not mortar the outside of joints. Do not use backhoe to drive pipe to make-up pipe joints.

3.04 HEADWALL, MANHOLE AND INLET INSTALLATION:

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- A. Construct all headwalls to line and grade and at locations shown. Construct in accordance with TXDOT 2004 Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Neatly cut off all pipe leads at the appropriate face of the headwall, manhole or inlet wall and finish with mortar.

END OF SECTION

SECTION 03001 – CONCRETE FORM WORK, REINFORCEMENT, AND PLACEMENT OF CONCRETE (CIVIL)

1. General Labor:
Work under this Section includes furnishing all labor for setting forms, trenching for beams, placement of moisture barrier, placement of reinforcement steel, placement and finishing of concrete slabs, walks and curbs shown, and removal of all forms.
2. Contractor will supply all materials including concrete, forms, stakes, bracing, nails, 6 mil poly vapor barrier, bar ties, tie wire, half bricks, any required expansion material, keyways, etc. New or like new forms and shall be used. Provide curing compound.
3. Formwork:
 - a. Conform to shape and dimensions shown on plan; maintain grade, square and level; proper bracing, clean and tight. Tolerance within 1/8" in 10'-0".
 - b. Provide for inserts, templates, and set anchor bolts furnished by others.
 - c. If existing structures are encountered, such as old concrete beams, which interfere with proper placement of this work, Owner will pay for labor required when approved by the Architect.
 - d. All forms shall be new or like new.
4. Reinforcement:
 - a. Accurately bend and place all bars. Use metal chairs.
 - b. Insure adequate cover on all steel
 - c. Place mesh in center of flatwork, lap one full mesh. (also concrete earth retainers.
 - d. Refer to Contract Drawings and details for detailed requirements.
 - e. Comply with requirements of ACI 315 manual for reinforced concrete structures.
5. Concrete:
All concrete shall be provided to achieve a minimum strength of 3,000 psi after 28 days. Utilize Portland cement, ASTM C-150 type I or III, 5 sacks per cubic yard; coarse aggregate, ASTM C-33, graded 1/4" to 1-1/2". No fly ash or calcium chloride permitted. Admixtures only with approval of engineer. Slump maximum 6".

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6. Placement of Concrete:
 - a. Furnish adequate labor to expeditiously place and finish all concrete for any given section as required by the Architect.
 - b. Thoroughly work concrete between and around reinforcement. Vibrate to secure complete filling and to minimize honeycomb.
 - c. Place concrete under good weather conditions; avoid heating (40° and rising). Comply with ACI 305 & 306 for requirements for hot and cold weather placement.
 - e. Finishing - Walks:
 - (1) Power float to level with cross slope of 1/4" per ft. for drainage.
 - (2) Wash and broom as approved by Architect.
 - f. Rub concrete faces immediately after forms removed to eliminate honeycomb.
 - g. For each 50 C.Y. of concrete placement, any concrete pour over 10 c.y. take 1 set of 4 cylinders. One specimen to be tested at 28 days and one specimen retained in reserve for later testing, if required. All testing shall be by independent lab approved by the Owner. Owner to pay for all testing.
 - h. For repair of defective surfaces, consult with the Architect before doing repairs.

END OF SECTION

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SECTION 03300 - CAST-IN-PLACE CONCRETE (CIVIL)

PART I - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary. Conditions and Division I Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
Precast concrete is specified in other Division 3 Sections.

1.03 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Division I Specifications Sections.
- B. Shop drawings for reinforcement, prepared for fabrication, bending and placement of concrete reinforcement. Comply with ACI SP-66 (88), "ACI Detailing Manual" showing bar schedules stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

ACI 318, "Building Code Requirements for Reinforced Concrete."

Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: 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.

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Use plywood complying with U.S. Product Standard PS-I "B-B (Concrete Form) Plywood, Class 1, Exterior grade or better, mill-oiled and edge-sealed, with each piece bearing legible edges and one side for tight fit.

- A. Forms for Cylindrical Columns and Supports: Metal, fiberglass-reinforced plastic, or paper for fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-ii-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- B. Form Coatings: Provide commercial formulation form-n-coating compounds with a maximum of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- C. Form Ties: Temporary- fabricated, adjustable-length removable or snap-off metaffonnties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to exposed surface.

2.02 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.
- C. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
- D. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I for general use unless otherwise noted on Plans.
- B. Normal Weight Aggregates: ASTM C 33 and as herein specified. Provide aggregates from a single source for exposed concrete.
- C. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
- D. Lightweight Aggregate: ASTM C 330.

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- E. Water: Drinkable.
- F. Admixtures General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer be compatible with other required admixtures.
- H. Products: Subject to compliance with requirements, provide one of the following:
 - "Air-Tite," Cormix
 - "Air Mix" or "Pen--Air," Euclid Chemical Co.
 - "Darex AEA" or "Daravair," W.R. Grace & Co.
 - "MB-VR" or "Micro-Air," Master Builders, Inc.
 - "Sealtight AEA," W.R. Meadows, Inc.
 - "Sika AER," Sika Corp.
- I. Water-Reducing Admixture: ASTM C 494, Type A.
- J. Products: Subject to compliance with requirements, provide one of the following:
 - "PSI N," Cormix.
 - "Eucon WR-75," Euclid Chemical Co.
 - "WRDA," W.R. Grace & Co.
 - "Pozzoloth Normal" or "Polyheed," Master Builders, Inc.
 - "Prokrete-N," Prokrete Industries.
 - "Plastocrete 161," Sika Corp.
- K. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G.
- L. Products: Subject to compliance with requirements, provide one of the following:
 - "PSI Super," Cormix.
 - "Eucon 37," Euclid Chemical Co.
 - "WRDA 19; or "Daracem," W.R. Grace & Co.
 - "PSP," Prokrete Industries.
 - "Sikament 300," Sika Corp.

2.04 RELATED MATERIALS

- A. Preformed Plastic Waterstops: Federal Specification SS-S-210A.

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

Synco-Flex Products, Inc.

- A.. Location of Waterstops: Waterstops shall be provided in all construction and expansion points as shown on the plans.
- B. Waterstops shall also be provided in all construction joints not shown on the plans as follows:
 1. All construction joints in structures confining liquids up to a point one foot above maximum water level.
 2. All structures enclosing dry areas at least one foot below finish grade.
- C. Granular Base: Evenly graded mixture of fine and course aggregates to provide, when compacted, a smooth and even surface below slabs on grade.
- D. Sand Cushion: Clean, manufactured or natural sand.
- E. Vapor Retarder: Provide vapor retarder cover over prepared base material under all slabs on grade for buildings.
- F. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

Polyethylene sheet not less than 8 mils thick.

- G. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type 1, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.
- H. Available products: Subject to compliance with requirements, projects that may be incorporated in the work include, but are not limited to, the following:

"Spartan-Cote," The Burke Co.
"Hardtop," Cormix.
"Eucocrete," Euclid Chemical Co.
"Masterkure," Master Builders, Inc.
"CS-309," W.R. Meadows, Inc.
"LR-151," Prokrete Industries.
"Kure-N-Seal," Sonneborn-Rexnord.

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"Stontop CS2," Stonhard, Inc.

- I. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.
- J. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:

"Burke Epoxy M.V.," The Burke Co.
"Euco Epoxy System #452 or #620," Euclid Chemical Co.
"Sikadur 32 Hi-Mod," Sika Corp.

2.05 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.

When air temperature between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.02 FORMS

- A. General: Design, erect, support, brace, and maintain form-work to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

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, rustictions, regrets, cliamfers, blocking, screeds, bulkheads, anchorages and insets, 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.

Provide temporary openings where interior area of Form-work is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to Form- to prevent loss of concrete mortar. Locate temporary openings in Form- at inconspicuous locations.

Chamfer all exposed corners and edges 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 framework 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 before concrete placement to prevent mortar leaks and maintain proper alignment.

3.03 VAPOR RETARDER/BARRIER INSTALLATION

- A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.

Lap joints 6 inches.

3.04 PLACING REINFORCEMENT

- A. General: 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.

Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.

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Place reinforcement to obtain at least minimum coverage's 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 laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

- A. Construction Joints: Locate install construction joints as indicated or, if not indicated, I locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.

Provide keyways at least 1- 1/2 inches deep in construction joints in walls and slabs and between walls and footings.

Accepted bulkheads designed for this purpose may be used for slabs.

Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

- B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to Form-n continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions.

- C. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Joint filler and sealant materials are specified in Division 7 Sections of these specifications.

- D. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8 inch wide by 1/4 slab depth or inserts 1/4 inch wide by 1/4 of slab depth, unless otherwise indicated.

Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

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Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

Joint sealant material is specified in Division 7 Sections of these Specifications.

3.06 INSTALLATION OF EMBEDDED ITEMS

- D. General: Set and build into work anchorage devices and other embedded items required or 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.
- E. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.07 PREPARATION OF FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before reinforcement is placed.

Do not allow excess form-n-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.08 CONCRETE PLACEMENT

- A. 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.
- B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that 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 to avoid segregation at its final location.

C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers of deeper than 24

inches 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 309.

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 inches 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.

D. 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 comers,

Bring slab surfaces to correct level with straightedge and strike off. 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.

E. Cold-Weather Placing: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade containing frozen materials.

Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

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- F. 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.

Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water.

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.

Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Engineer.

3.09 FINISH OR FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. 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 inch in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

3.10 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces 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 tolerances for floor flatness (Ff) of 15 and floor levelness (F I) to 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sanbed terrazzo; and as otherwise indicated.

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After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, 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 tolerances of (Ff) 18 - F] 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surface to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film 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 surface leveled to tolerances of Ff 20 - Ff 17. Grind smooth surface defects that would telegraph through applied floor covering system.

- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with this-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen concrete surface by brooming with five-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.11 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

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 7 days.

- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

Provide moisture curing by one of the following methods.

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Keep concrete surface continuously wet by covering with water.

Use continuous water-fog spray.

Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

Provide moisture-cover curing as follows:

Cover concrete surfaces with moisture-retarding cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by water proof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and water proof tape.

Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:

Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen as disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied to concrete.

3.12 SHORES AND SUPPORTS

- A. General: Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

Extend shoring from ground to roof for structures 4 stories or less, unless otherwise permitted.

Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to support work without excessive stress or deflection.

Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.13 REMOVAL OF FORMS

- A. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has

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attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place 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.

3.14 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged formfacing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork. General: 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 de F (10 de C) for 48 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.

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 Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. 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.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with comers, intersections, and terminations slightly rounded.
- C. 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.
- D. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as schedules. Maintain accurate location of reinforcing steel during concrete placement.

END OF SECTION

SECTION 03360
SPECIAL CONCRETE FLOOR FINISHES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: This section specifies polished concrete
- B. Related Sections:
 - 1. Section 079200 “Joint Sealants” for sealants in concrete floor surfaces

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 302.1R – Guide for Concrete Floor and Slab Construction
- B. ASTM International
 - 1. ASTM C309 – Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
 - 2. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete
 - 3. ASTM C779 – Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
 - 4. ASTM C805 – Standard Test Method for Rebound Number of Hardened Concrete
 - 5. ASTM E 1155 – Standard Test Method for Determining Floor Flatness and Levelness Using the F number system

1.3 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide polished flooring that has been selected, manufactured and installed to achieve the following
 - 1. Abrasion Resistance: ASTM C779, Up to 400% increase in abrasion resistance
 - 2. Reflectivity: Increase of 35% as determined by gloss meter
 - 3. Waterproof Properties: RILEM Test Method 11.4, 70% or greater reduction in absorption
 - 4. Impact Strength: ASTM C805, Up to 21% increased impact strength
 - 5. Must meet or exceed ADA/OSHA suggested 0.5 standard value for the Static Co-efficient of Friction
- B. Design Requirements
 - 1. Hardened Concrete Properties
 - a. Minimum Concrete Compressive Strength: 3500 psi
 - b. Normal Weight Concrete, No light weight aggregates
 - c. Non-air entrained concrete
 - 2. Placement Properties for New Concrete
 - a. Natural concrete slump of 4 1/2 inches – 5 inches, Admixtures may be used
 - b. Flatness Requirements
 - 1) Overall Ff 50
 - 2) Local Ff 35

3. Hard-Steel Trowelled (3 passes) Concrete
 - a. No burn marks. Finish to ACI 302.1R, Class 5 floor
4. Curing Options
 - a. Membrane forming curing compounds (ASTM C309, Type 1, Class B, all resin, dissipating cure). Acrylic curing and sealing compounds not recommended
 - b. Sheet membrane (ASTM C171) Polyethylene film not recommended
 - c. Damp curing: Seven day cure

1.4 PRE INSTALLATION MEETINGS

- A. Pre installation Conference: Conduct conference at project site

1.5 Action Submittals:

- A. Product Data: For each type of product indicated
- B. LEED Submittals
 1. Product Data for Credit IEQ 4.2; For liquid applied flooring components, documentation including printed statement of VOC content

1.6. INFORMATIONAL SUBMITTALS

- A. Test Reports: Certified test reports, from an Independent Testing Laboratory, showing compliance with specified performance criteria and physical properties as cited in "Performance Requirements"
- B. Certificates:
 1. Product and installer certificates signed by the manufacturer certifying materials meet specified performance characteristics and criteria and physical requirements
 2. Current installation contractor's certificate signed by manufacturer declaring contractor as a certified installer of polishing system, prior to bidding of project.

1.7 CLOSEOUT SUBMITTALS:

- A. Warranty: Submit warranty documents specified
- B. Maintenance Data: For polished concrete finishing to include in maintenance manuals. Also include the following
 1. Manufacturer's instructions on maintenance renewal of applied treatments
 2. Protocols and product specifications for joint filling, crack repair and/or surface repair.

1.8 QUALITY ASSURANCE

- A. Manufacturers Qualifications:
 1. Manufacturer has a minimum of 5 years experience in manufacturing components similar to or exceeding requirements of project.
 2. Manufacturer must be able to provide technically trained field representative during construction and approving application method
- B. Installer Qualifications

1. Installer experienced in performing work of this section who has specialized in installation of polished concrete for a minimum of 5 years
2. Installer shall provide a minimum of 5 projects similar size and scope
3. Installer trained and having current certification for RetroPlate Concrete Polishing System

C. Mock-Ups

1. Mock-up size: 10'x10' floor area at job site, at location as directed under conditions similar to those which will exist during actual placement. Divide mock-up area into 4 equal zones, allowing for sequential attempts to determine amount of aggregate exposure, and color (if required) and shine selection
2. Mock-up will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application, color selection and shine level.
3. Allow 24 hours for inspection of mock-up before proceeding with work
4. When accepted, mock-up will demonstrate minimum standard of quality required for this project

Class B— Salt/Pepper Finish

Level 3 – High Gloss; up to 1500 grit polish, a gloss reading of 45- 50 or higher

- D. Sequence With Other Work: Comply with Manufacturer's written recommendations for sequencing construction operations

1.9 DELIVERY, STORAGE & HANDLING

A. Ordering:

1. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays

B. Delivery:

1. Deliver materials in manufacturer's original packaging with identification labels and seals intact

C. Storage and Protection:

1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer
2. Protect Concrete Slab
 - a. Protect from petroleum stains during construction
 - b. Diaper all hydraulic lifts and power equipment
 - c. Restrict vehicular parking, drop cloths will be placed under vehicles parked on slab
 - d. No pipe cutting machinery will be used on interior floor slab
 - e. Steel will not be placed on interior floor slab to avoid rust staining
 - f. No acids or acidic detergents will come into contact with slab

1.10 Project Conditions

- A. Environmental Limitations: Do not install work until ambient temperature and humidity conditions are maintained at levels indicated in reference standards

1.11 WARRANTY

- A. Project Warranty: Refer to Contract Conditions for project warranty provisions.
- B. Manufacturer's Warranty: Submit for owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit, other rights Owner may have under Contract Documents

PART 2 – Products

2.1 PRODUCTS, GENERAL

- A. Ensure concrete finishing components and materials are from single source, from single manufacturer

2.2 POLISHED CONCRETE FINISHING PRODUCTS

- A. Basis of Design Product: Advanced Floor Products, RetroPlate Systems
 - 1. Contact: P O Box 80533, Provo, UT 84605, Telephone: (800)998-5664; Deke Rife, (402)598-0801, deke@retroplatesystem.com
- B. Proprietary Products/Systems:
 - 1. Hardener, Sealer, Densifier: RetroPlate 99 – penetrating, water based, odorless liquid, VOC compliant, environmentally safe chemical, will leave no film on surface
 - 2. Ameripolish Dyes shall be supplied thru Advanced floor products
 - 3. Joint Filler: CreteFill , Semi-rigid, 2 component, self leveling, 100%solids, rapid curing, polyuria control joint and crack filler with a choice of 65, 75 or 85 Shore-A hardness. Depending on project needs
 - 4. Cleaning Solution: CreteClean Plus
 - 5. Stain Protector: RetroGuard
- C. No Substitutions Allowed
- D. Dye Color: Final dye color will be determined during mock-up review

PART 3 – Execution

3.1 MANUFACTURERS INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installations and Advanced Floor products Spec-Data sheets.

3.2 EXAMINATION

- A. Site Verification of Conditions
 - 1. Verify that concrete substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of finishing materials
 - 2. Verify concrete is cured to 28 days or 3500 psi strength

3.3 PREPARATION

- A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of Concrete finishing materials
- B. Examine surface to determine soundness of concrete for polishing

3.4 INSTALLATION

A. Floor Surface Polishing and Treatment

1. Provide polished concrete floor treatment in entirety of slab indicated by drawings. Provide consistent finish in all contiguous areas
2. Apply floor finish prior to installation of fixtures and accessories
3. Diamond polish concrete floor surfaces with proper grinding equipment, a minimum of 1,100 lb machines, with a minimum of 685lbsof head pressure, recommended by Polishing system representative
 - a. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Level of shine shall match that of approved mock-up. Floors will be ground using a minimum of 50 grit diamonds to open the floor. The floors will then be passed in steps necessary to remove the scratches from the previous diamonds. The floor will be finished with a 1,500 grit diamond. The floor will need to achieve a minimum gloss meter reading of 45, gloss meter readings will be taken before Retro Guard is applied
 - b. Expose aggregate in concrete surface only as determined by approved mock-up
 - c. All concrete surfaces shall be as uniform in appearance as possible
4. Apply RetroPlate 99, Hardener, Densifier as follows;
 - a. Apply RetroPlate 99 at 200 sq. ft. per gallon, according to manufacturer's directions
 - b. Apply RetroGuard according to manufacturer's directions
 1. Remove defects and re-polish defective areas
 2. Finish edges of floor finish adjoining other materials in a clean and sharp manner

3.6 FINAL CLEANING

- A. Mechanically scrub treated floors for seven days with soft to medium pads using approved Cleaning solution (Crete Clean Plus)
- B. Upon completion, general contractor must remove surplus and excess materials, rubbish, tools and equipment

3.7 PROTECTION

- A. Protect installed product (Polished floors) from damage during construction

End of Section 03 35 43

MORTAR

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to furnish the Masonry Mortar indicated by the Contract Documents and furnish all supplementary items necessary for its 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.
- C. Application of Mortar used in the installation of masonry units is specified in each respective Unit Masonry Section and is not included in the work required for this Section.

1.02 SUBMITTALS:

- A. Submit product data on all mortar and admixtures.
- B. Submit certification that mortar and grout material meet ASTM standards.

1.03 PRODUCT DELIVERY AND STORAGE:

- A. Delivery: Deliver materials to Project site dry and in unbroken containers.
- B. Storage: Store materials above ground in waterproof shelters.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
1. PORTLAND CEMENT:
- Capitol Lone Star
Trinity Texas Industries
Universal Atlas Cement
2. LIME:
- Gibsonburg Lime Products Co., Tiger Limes
Texas Lime Company
United States Gypsum Company
National Gypsum Company
3. WATER PROOFING ADMIXTURE:
- Master Builders - Omicron Mortarproofing
Sonneborn Building Products - Hydracide
W. R. Grace - Hydratite Plus
4. MORTAR COLOR:
- Gray -
- B. Refer to Section 01631 - Substitutions and Product Options for manufacturers not listed above.

2.02 MATERIALS:

- | | | |
|----|---|-----------------------|
| A. | PORTLAND CEMENT: | ASTM C150, TYPE I. |
| B. | HYDRATED LIME: | ASTM C207, Type S. |
| C. | FINE AGGREGATE: | ASTM C144. |
| D. | COARSE AGGREGATE: | ASTM C404, Size No. 8 |
| E. | WATER : Clean and free of deleterious acids, alkalis, or organic matter. | |
| F. | WATERPROOFING ADMIXTURE: Omicron Mortarproofing, manufactured by Master Builders. | |
| G. | GROUT ADMIXTURE: "Fluidifier" by Master Builders. | |

H. SEALER:

2.03 PROPORTIONS AND MIXING:

- A. Meet requirements of ASTM C270 and proportion mortar types as specified.
- B. Meet requirements of ASTM C476 for masonry grout and proportion grout type as specified.
- C. Proportion material accurately and mix thoroughly by machine to a uniform consistency and color. Mix mortars with the maximum amount of water consistent with workability.
- D. Do not use mortar that has begun to set. Retemper mortar by adding water if mortar begins to stiffen from evaporation or absorption of a part of the mixing water. Use and place mortar in final position within 2½ hours after mixing.

PART 3: EXECUTION:

3.01 INSTALLATION:

- A. See specific section of Masonry Materials for installation instructions.

3.02 MORTAR SCHEDULE:

- A. Exterior Masonry Walls:
 - 1. Mortar - Type S, ASTM C270.
 - 2. Waterproofing Admixture - one pound per cubic foot of cementitious materials.
- B. Interior Masonry Partitions:
 - 1. Mortar - Type N, ASTM C270.
- C. Interior Paving Tile:
 - 1. Mortar - Type S, ASTM C270.
- D. Exterior Paving Tile:
 - 1. Mortar - Type M, ASTM C270.

3.03 GROUT SCHEDULE:

- A. Paving Tile:
 - 1. Portland Cement - one part.
 - 2. Fine Aggregate - three parts.
 - 3. No lime.
 - 4. Sealer

END OF SECTION

SECTION 04210

BRICK MASONRY

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to furnish the Brick Masonry indicated by the Contract Documents and furnish all supplementary items necessary for its 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.
- C. Mortar required in the installation of Brick Masonry Units is specified in the Mortar Section and its installation is included in the work required for this Section.

1.02 SUBMITTALS:

- A. Within fifteen {15} calendar days after award of contract submit the following:
 - {1} Submit technical data for each type masonry wall reinforcement, anchors, and ties.
 - {2} Submit sample panel of brick specified showing full color range.

1.03 MOCK-UP:

- A. Lay up, where directed at Site, mock-up panel 8 feet high by 6 feet wide using full range of brick selected for facing, mortar inclusive of a small exterior window including the installation of base flashing, window flashing, pre-fabricated end dams, weep holes, rigid board. Insulation, waterproofing, and mortar net.
- B. Do not proceed with brickwork on Project until sample panel has been approved for color and shading. Approved panel shall be the standard of comparison for workmanship and materials. Do not destroy, alter, or move panel until brickwork is completed.

1.04 STORAGE AND HANDLING:

- A. Handle materials in a manner to prevent breakage and chipping.
- B. Store materials on platforms raised free of the ground and protect materials with stainproof tarpaulin covers.

1.05 ENVIRONMENTAL CONDITIONS:

- A. Do not lay brick when the temperature of the outside air is 40°F or less, or will fall below 40°F twenty-four (24) hours after laying.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable provided it complies with the Contract Documents.
 - 1. REINFORCEMENT, ANCHORS AND TIES:
 - AA Wire Products Company
 - Duro-O-Wal
 - Heckman Building Products, Inc.
 - Hohmann and Barnard, Inc.
 - Masonry Reinforcing Corp. of America
 - National Wire Products Corp.
- B. Refer to Section 1631 - Substitutions and Product Options for manufacturers not listed above.

2.02 MATERIALS:

- A. FACE BRICK:
FIELD: **Builder's Special Face Brick : By Acme Brick, to match existing**
ACCENT: **Builder's Special Face Brick : By Acme Brick, color to be selected by architect**

Wire cut texture comply with ASTM C216, Grade SW, Type FBS.

B. JOINT REINFORCEMENT, TIES AND ANCHERING DEVICES:

1. Interior masonry not exposed to exterior or earth, DUR-O-WALL TRUSS Hot dip galvanized steel wire ASTM A82 for uncoated wire and with ASTM A123, Class B-2 (1.5 oz per sq. ft. or wire surface) for zinc coating applied after prefabrication into units.
2. Exterior masonry exposed to exterior and in contact with earth, DUR-O-EYE, LADUR-EYE adjustable assemblies for required wall thickness zinc-coated (galvanized) steel sheet; carbon steel with zinc coating complying with ASTM A525, Coating Designation G90.
3. Refer to structural specification for wing sizes.

C. CLEANING AGENT: TRISODIUM PHOSPHATE (Calgon) and household detergent.

D. WATER: Clean and free of deleterious acids, alkalies, or organic materials.

E. CONTROL JOINT SPACER: As specified in the CONCRETE UNIT MASONRY Section.

F. PREMOLDED NEOPRENE PAD: ASTM D-1056SCE-43, R431-N by RUBATEX CORP., 3" wide, by 1/8" thick.

G. WEEPS: Cell vent D/A 1006 weep hole size to match brick size and mortar joint color grey Duro-O-Wall Inc. or equal.

H. REINFORCING BARS: ASTM A615, Grade 60 deformation per ASTM A305, number 4 bars unless otherwise indicated on structural drawings.

I. MORTAR NET: 1" Thick, 10" high x 5 ft long by Hohman & Barnack.

PART 3: EXECUTION:

3.01 PREPARATION:

- A. Provide, install and maintain all scaffolding, staging and forms of protection necessary for execution of the work; substantially constructed, maintained, moved and dismantled as required to properly follow the sequence of the operation.
- B. Provide and install all shores and centering for the work, constructed true to required shape, size and form, well braced and made rigid in all parts, and capable of supporting and sustaining the loads to which subjected.
- C. Leave all shores and centering in place until the masonry has sufficiently set to safely carry its own weight and the added loads of construction. Shore all free standing wall until protected from damage by windstorm.
- D. Examine surfaces to receive masonry and report any discrepancies before commencing work. Accept no former measurements, but layout work according to the plans and figures thereon.

3.02 LAYING BRICK:

- A. All brick having absorption rates determined in accordance with ASTM C67 in excess of 0.025 oz. per sq. inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting shall be such as to insure that each unit is nearly saturated, surface dry when laid.
- B. Lay brick plumb, level and true to a line in running bond or as indicated. Lay 3 courses to 8" vertically with uniform horizontal and vertical joints. Glaze brick and tile shall be laid stack bond.
- C. Lay brick in full bed of mortar with head and edge joints completely filled. Spread mortar for bed joint only so far ahead of laying units that the mortar will be plastic when the units are laid. Butter end of brick for head joints with ample mortar so the vertical joint is completely filled with mortar when brick is shoved into place.

- D. Rock closures into place with both head joints and closure space spread with ample mortar. Shove against the two adjacent bricks in place so that both horizontal and vertical joints are completely filled. Do not disturb previously laid brick.
- E. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after setting in place. Where adjustment must be made after initial setting, remove mortar and replace with fresh mortar.
- F. Fill the vertical, longitudinal joint between brick and backup as the course is laid, by pouring or slushing the vertical joint full of grout with the same mortar as used for setting.
- G. Keep cavity clear by laying a board, 3/4" x cavity width, across a level of the ties to catch the droppings. As masonry reaches the next level for placing ties, raise the board, clean it and lay it on the ties at that level.
- H. Finish joints that will remain exposed with a tool slightly larger than the width of the joint, to form a concave surface. Tool joints after the mortar has taken its initial set and in such a manner as to squeeze the mortar back into the joint. Tool vertical joint first.
- I. Fill all nail or line-pine holes with fresh mortar immediately upon removal. Provide weeps in head joints 16" on centers, in first horizontal course above flashings. Keep cavity side of weep free from mortar or accumulated materials.
- J. Cut brick, where necessary for fitting or bonding, with a power saw to insure straight, evenly cut edges.
- K. Cover tops of walls at end of day's work and when rain or is imminent with waterproof membrane. Overhang two feet on each side of wall and anchor securely. Protect masonry from weather or construction damage.
- L. Stop off longitudinal run of masonry where absolutely necessary by racking one-half length in each course. Remove loose mortar before new work is started and slightly wet old work.

3.03 ANCHORING:

- A. Space anchors not over 16" on centers vertically and 24" on centers horizontally. Locate anchors at vertical and horizontal supports, and at other locations as indicated.
- B. Bond brick to backup with adjustable wall ties and joint reinforcing installed in adjacent masonry.
- C. Maintain a minimum of 1/2" clearance between masonry and concrete or steel structure. Keep space free of mortar and other rigid material.

3.04 CONTROL AND EXPANSION JOINTS:

- A. Locate expansion joints where they occur in backup material. Locate control joints not to exceed 25'-0" on center. Keep vertical joints straight, true and continuous from top to bottom of masonry. Verify locations of control joints with Architect.
- B. Keep joints clean of mortar as work progresses. Build-in control joint spacer at control joints and flashing at expansion joints.

3.05 EMBEDDED ITEMS:

- A. Build in flashings, sleeves, anchors, clips and accessories as work progresses. Install loose lintels, as indicated, in full beds of mortar.

3.06 CLEANING:

- A. Keep face of brickwork free from excess mortar while laying brick. Brush with dry fiber brush prior to wet cleaning.
- B. Clean brickwork that will remain exposed promptly with fiber brushes, clean water and cleaning agent. Use of wire brushes, commercial cleaner or acid permitted only with specific approval.
- C. Repair and repoint defective work. Replace broken, damaged or discolored brick.

END OF SECTION

SECTION 04720

CAST STONE

PART 1: GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Extent of Cast Stone is indicated on the drawings.

1.03 DEFINITIONS:

- A. Cast Stone: Any reference to stone(s) and/or stonework is a reference to cast stone(s) and the Work of this Section.

1.04 QUALITY ASSURANCE:

- A. Fabricator Qualifications: Only a firm which has had a minimum of 5 years successful experience in the fabrication of Cast Stone similar to the units required for this project will be acceptable. Fabricator must have sufficient production capacity to produce the required units without causing any delay in the work.

1.05 FABRICATION QUALIFICATIONS:

- A. Cast Stone shall be sound, weather resistant, and of sizes and shapes indicated on Drawings.
- B. Produce Cast Stone units at a fabricating plant engaged primarily in the manufacturing of similar units, unless plant fabrication is impractical.
- C. If units are produced at locations other than Cast Stone fabricating plants, maintain procedures and conditions for quality control which are equivalent to plant production.

1.06 CONCRETE TESTING SERVICE:

- A. Engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.

1.07 MATERIALS AND INSTALLED WORK:

- A. May require testing and retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

1.08 SUBMITTALS:

- A. Samples for Initial Selection Purposes: Submit samples of the following materials:
- B. Cast Stone samples in small scale form showing full extent of colors and textures available for each type of Cast Stone unit required.
- C. Colored pointing mortar samples showing full extent of colors available.
- D. Samples for Verification Purposes: Submit the following samples.
- E. Cast Stone samples for each type of Cast Stone unit required; include in each set the full range of exposed color

and texture to be expected in completed work by providing a minimum of five samples.

- F. Colored pointing mortar samples for each color required showing the full range of color which can be expected in the finished work. Label samples to indicate type and amount of colorant used.
- G. Submit shop drawings in accordance with provisions of Section 01300 and show cross section with reinforcement and anchorage. Provide in plan or elevation each individual unit numbered in sequence for installation.
- H. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

1.09 DELIVERY, STORAGE AND HANDLING:

- A. Deliver Cast Stone units to the project site in such quantities and at such times as will assure the continuity of the installation.
- B. Store units at the project site in a manner that ensures against cracking, distortion, staining, or other physical damage.
- C. Lift and support units at the same points where they will be supported in the finished structure, unless otherwise detailed or approved by the Architect Engineer.

1.10 PROJECT CONDITIONS:

- A. Installer shall examine all parts of the supporting structure and the conditions under which the Cast Stone work is to be installed.
- B. Verify dimensions of supporting structures at the project site and adjust final shop drawings to reflect actual field dimensions.
- C. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- D. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.11 DESIGN MODIFICATIONS:

- A. May be made only as necessary to meet field conditions to insure proper fitting of the work, and only as acceptable to the Architect. Maintain the general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown. Provide complete design calculations and drawings prepared by a registered engineer, if requested by the Architect.

1.12 STAINING:

- A. Prevent sealant from staining face of Cast Stone to be left exposed.
- B. Remove immediately all sealant in contact with face of such stone.
- C. Protect sills, ledges and projections from droppings of sealant.

PART 2: PRODUCTS

- A. **CAST STONE** Color: **match existing**.
- B. **Formwork**: Comply with applicable requirements of Division 3 section "Concrete Work". Accurately construct rigid forms that will cast required sections with selected finish.
- C. **Reinforcement**: Comply with applicable requirements of Division 3 section "Concrete Work". for materials, fabrication and installation of reinforcement for Cast Stone units as herein specified.

2.01 CAST STONE MATERIALS:

- A. **Cement**: ASTM C150 type 1
 - 1. Lehigh Atlas waterproofed white cement or equal for facing mix.
 - 2. Trinity Portland type 1 common cement or equal for back up mix.
- B. **Aggregates**: All materials used shall be washed, graded, and of known durability.
 - 1. **Facing**: Limestone
 - 2. **Color**: Match Architect's sample.
 - 3. **Back Up**: Washed concrete sand, pea gravel, or graded limestone as produced by Gifford-Hill & Company, Inc. or approved equal.
- C. **Water**: Clean, free from deleterious amounts of acids, alkalis or organic material.
- D. **Reinforcement**: Reinforce Cast Stone with steel rebar or wire mats as required.
- E. **Waterproofing**: Cast Stone to have one coat of 5% silicone treatment, factory applied to all exposed faces.

2.02 CONNECTION AND REINFORCEMENT MATERIALS:

- A. Steel Plates: Structural quality, hot-rolled carbon steel complying with ASTM A 36 OR ASTM A 283, Grade C.
- B. Bar-size Steel Shapes, Steel Bar Flats, and Steel Bar Rounds: ASTM A 36 OR ASTM A 306, Grade 65.
- C. Reinforcement: ASTM A 615, Grade 60.

2.03 MORTAR AND GROUT MATERIALS:

- A. **Portland Cement**: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide grey or white cement as needed to produce mortar color required.
- B. **Hydrated Lime**: ASTM C 207. Type S.
- C. **Aggregate**: ASTM C 144: and as indicated below.
 - 1. **For joints narrower than 1/4"** use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent the No. 16 sieve;
 - 2. **For pointing mortar** use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. **Colored Mortar Aggregates**: Ground marble, granite, or other sound stone, as required to match Architect's sample.
- D. **Colored Mortar Pigments**: Natural and synthetic iron oxides and chromium oxides, compound for use in mortar mixes. Use only pigments with record of satisfactory performance in stone mortars.

1. Available Products: Subject to compliance with requirements, colored mortar pigments which may be incorporated in the work include, but not limited to, the following:
 - a. "SGS Mortar Colors"; Solomon Grind-Chem Services, Inc.
 - b. "True Tone Mortar Colors"; Davis Colors, a subsidiary of Rockwood Industries.
 - c. Sonobrite; Sonneborn B.P. Div., Rexnord Chemical Products, Inc.
- E. WATER: Clean, non-alkaline and potable.

2.04 STONE ANCHORS AND ATTACHMENTS:

- A. Provide anchors and attachments of type and size required to support stonework fabricated from the following metals for conditions and anchors indicated below:
 1. Stainless Steel, AISI Type 304, for anchors in direct contact with stone.
 2. Cast or malleable iron for adjustable inserts embedded in concrete and not in direct contact with stone.
 3. Hot-Dip Galvanized Steel as follows;
 - a. For anchor bolts, nuts and washers not in direct contact with stone; comply with ASTM A 307, Grade A, for material and ASTM C 153, Class C, for galvanizing.
 - b. For steel plates, shapes and bars not in direct contact with stone; comply with ASTM A 36 for materials and ASTM A 123 for galvanizing.

2.05 STONE ACCESSORIES:

- A. Setting Buttons: Lead or resilient plastic buttons, non-staining to stone, sized to suit joint thicknesses and bed depths of stonework involved without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting button.
- B. Plastic Tubing: Medium density polyethylene, outside diameter of 1/4" and of length required to extend between exterior face of stone and cavity behind.

2.06 MORTAR AND GROUT MIXES:

- A. General: Do not add admixtures including coloring pigments, air entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds, or calcium chloride, unless otherwise indicated.
- B. Mixing: Combine and thoroughly mix cementitious materials, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content, unless otherwise indicated.

PART 3: EXECUTION:

3.01 FABRICATION:

- A. Manufacturing Process: Work Cast Stone in forms with Vibro-Tamp or similar vibrating equipment.
- B. Curing: All curing shall be done in protected areas and under water treatment for a minimum of three (3) days. Stone shall remain in curing bed for twenty-one (21) days unless otherwise authorized.

- C. Built-in Anchorages: Accurately position built-in anchorages devices and secure to the formwork. Locate anchorages where they do not affect the position of main reinforcement or placing of concrete.
- D. Identification: Provide permanent markings in cast units to identify pick-up points and orientation in the structure, complying with the markings indicated on the final shop drawings.

3.02 INSTALLATION:

- A. Tool exposed joints when "thumb-print" hard.
- B. Joint Thickness: Lay Cast Stone with joints 3/8" thick or as recommended by Cast Stone manufacturer.
- C. Lay plumb and true to lines.
- D. Lay with completely filled mortar joints where required.
- E. Do not furrow bed joints.
- F. Rock Cast Stone into place where bed joints are required.
- G. Anchor Cast Stone to abutting concrete or steel as indicated on Drawings.
- H. Do not install Cast Stone units until concrete has attained its design ultimate compressive strength.
- I. INSTALLATION TOLERANCES: Install stone units without exceeding the following tolerance limits:
 - 1. Variations from Plumb: 1/4" in any 20' run or story height 1/2" total in any 40' or longer run.
 - 2. Variations from Level or Elevation: 1/4" in any 20' run: 1/2" in any 40' run; total plus or minus 1/2" at any location.
 - 3. Variation from Theoretical Position in Plan: Plus or minus 1/4" maximum at any location.
 - 4. Offsets in alignment of adjacent members at any joints; 1/16" in any 10' run; 1/4" maximum.
- J. Items embedded on other Construction: Deliver anchorage items which are to be embedded or secured in other construction before the start of such work. Provide setting diagrams, templates, instruction and directions as required for installation.
- K. Concrete Mix Design and Testing:
 - 1. Cure 2" cube test specimens and test in accordance with ASTM C-109.
 - 2. Conduct compressive strength tests, one for each day of casting. Test one {1} specimen cylinder at twenty-eight {28} days, and retain one {1} specimen cylinder for further testing as may be required.
 - 3. Produce standard-weight concrete consisting of the required Portland cement, aggregates, admixtures, and water to provide the following:

Compressive Strength:	6,500 psi minimum at 28 days	ASTM C1194
Absorption:	6% maximum	ASTM 1195
- L. Performance Requirements:

1. In-place Cast Stone units may be rejected for any one of the following:
 - a} Exceeding the specified installation tolerances.
 - b} Damage during construction operations.
 - d} Exposed-to-view surfaces which develop surface finish deficiencies.

3.03 SETTING STONEWORK WITH MORTAR:

- A. **WET STONES** which are dry at time of setting by drenching or sponging them with water.
- B. **SET STONES** in full bed of mortar with vertical joints slushed full, unless otherwise indicated.
 1. **Place setting buttons** of adequate size, in sufficient quantity, and of same thickness as indicated joint width, to prevent mortar from squeezing out and to maintain uniform joint widths. Hold buttons at last one joint width back from face of stones.
 2. **Do not set heavy stones** or projecting courses until mortar in courses below has hardened sufficiently to resist being squeezed out of joint.
 3. **Fill anchor holes** with mortar.
- C. **SUPPORT PROJECTING STONES** by props or anchors until wall above is set.
- D. **EMBED ENDS OF LUGGED SILLS** in mortar; leave balance of joint open until final pointing.
- E. **RAKE OUT MORTAR** from joints to depths equal to 2-1/2 times their widths but not less than 1/2" nor less than that required to expose sound mortar for joints pointed with mortar, or to provide sufficient depth for sealant backing for joints pointed with sealants.
- F. **PREPARE STONE JOINTS SURFACES** for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not greater than 3/8" until a uniform depth is formed; compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- G. **POINT STONE JOINTS** by placing mortar in three {3} layers with each of first and second layers filling approximately two-fifths of joint depth and third layer remaining one-fifth. Fully compact each layer and allow to become thumbprint hard before applying next layer.
- H. **TOOL JOINTS** with a round joiner having a diameter 1/8" larger than width of joint, when pointing mortar is thumbprint hard.

3.04 ADJUSTING AND CLEANING:

- A. **REMOVE AND REPLACE STONEWORK** of the following description:
 - 1} Broken, chipped, stained or otherwise damaged stones.
 - 2} Defective joints.
 - 3} Stones and joints not matching approved samples and field-constructed mock-ups.
 - 4} Stonework not complying with other requirements indicated.
- B. **REPLACE** in manner which results in stonework matching approved samples and field-constructed mock-ups, complying with other requirements and showing no evidence of replacement.
- C. **CLEAN STONEWORK** not less than six {6} days after completion of work, using clean water and stiff bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh

fillers, or other materials or methods which could damage stone.

3.05 PROTECTION:

- A. **PROVIDE FINAL PROTECTION** and maintain conditions in a manner acceptable to Fabricator and Installer, which ensures stonework being without damage or deteriorations at time of Substantial Completion.

END OF SECTION

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1: GENERAL:

1.01 SUMMARY:

- A. Section Includes: Light-gage framing and required supplementary items.

1.02 REFERENCES:

- A. American Iron and Steel Institute: AISI - Specification for Design of Cold-Formed Steel Structural Members.
- B. American Society for Testing and Materials:
1. ASTM A 90 - weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 2. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM A 446 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
 4. ASTM A 570 - Hot-Rolled Carbon Steel Sheet and Strip Structural Quality.
 5. ASTM A 611 - Steel, Cold-Rolled Sheet, Carbon, Structural.
 6. ASTM A 645 - Steel Sheet, Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated.
- C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
 2. AWS D1.3 - Light Steel Welding Code - Sheet Steel.
- D. Association of Wall and Ceiling Industries: AWCI - Specifications Guide for Cold Formed Steel Structural Members.
- E. Steel Structures Painting Council: SSPC - Steel Structures Painting Manual.
- F. Metal Framing Manufacturers Association: MFMA - Guidelines for the Use of Metal Framing.

1.03 SYSTEM DESCRIPTION:

- A. Design Criteria:
1. Comply with AISI Specification for Design of Cold-Formed Steel Structural Members.
 2. Calculate structural properties of framing members in accordance with AWCI, MFMA, or AWS D1.3 requirements.
- B. Design and size components of wall system to withstand dead and live loads, and loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with SSBC using a wind speed of 90 mph., Exposure C, importance factor of 1.15 to establish wind pressure.
1. Maximum Allowable Deflection: $L/460$ for stud by itself and $L/660$ for the complete wall system.
 2. Design system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 3. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 4. Stud spacing and depth shall be as indicated on drawings.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's instructions for securing studs to tracks and other framing connections.
- B. Shop Drawings:
 - 1. Indicate component details including size and gage designations, bracing, splices, bridging, framing openings, bearing, anchorage, loading, temporary bracing, welds, type and location of mechanical fasteners and accessories, or items required of other work for complete installation.
 - 2. Detail stud layout.
- C. Quality Control Submittals:
 - 1. Design Data: Submit stamped and sealed structural design calculations prepared by Professional Engineer that metal framing complies with specified load requirements.
 - 2. Certificates: Certify that each welder has satisfactorily passed AWS qualification test for welding process involved and, if pertinent, has undergone recertification.

1.05 QUALITY ASSURANCE:

- A. Qualifications:
 - 1. Professional Engineer: Licensed to practice in state where project is located and is experienced in providing engineering services of the kind indicated.
 - 2. Welders: Qualify welding processes and welding operators in accordance with AWS D1.1 and AWS D1.3.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Protect light-gage steel framing members from weather exposure and damage. Deliver to project site in bundles, fully identified with name, type and grade. Store off ground in dry, protected with suitable, venting waterproof coverings.

PART 2 - PRODUCTS:

2.01 MATERIALS:

- A. Studs, Track, Bracing, Furring and Bridging:
 - 1. Formed galvanized sheet steel G-60 complying with ASTM A 446, Grade A, ASTM A 570, ASTM A 611, or ASTM A 645.
 - 2. Studs: Minimum 18 gage.
 - a. For 18 gage units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.
 - b. For 16 gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 446, A 570, or A 611.
 - 3. Open box shaped sections, punched web for studs and solid web for track.
 - 4. Structural properties of sections shall be computed in accordance with AISI.
- B. Angles, Plates, Gussets, Clips: Galvanized formed steel, thickness determined for conditions encountered, 20 gage minimum, manufacturer's standard shapes.
- C. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A 123, hot dip galvanized to 1.25 oz./sq.ft.
- D. Anchorage Devices: Power driven or powder actuated fasteners, drilled expansion bolts or screw with sleeves.

- E. Welding: In conformance with AWS D1.1 and AWS D1.3.
- F. Touch-Up Primer for Galvanized Surfaces: High zinc dust content galvanizing repair paint conforming to FS TT-P-645 or SSPC - Paint 20, Type II Organic zinc rich.

2.02 FABRICATION:

- A. Galvanize, touch-up and prime metal materials used on exterior wall framing.
- B. Fabricate assemblies and framed sections of sizes and profiles required with joints fitted, secured, reinforced and braced to suit design requirements.
- C. Attach similar components by welding. Attach dissimilar components by welding, bolting or screw fasteners in accordance with manufacturer's recommendations. Do not wire tie framing components.

PART 3 - EXECUTION:

3.01 ERECTION:

- A. Install metal framing system in accordance with manufacturer's recommendations.
- B. Joining of members shall be made with self-drilling screws or welding. Wire tying of framing members shall not be permitted.
- C. Metal framing may be attached with sheet metal screws at joints according to manufacturer's recommendations except where noted to be welded on details.
- D. Attachments made with screws, shall be self-drilling screws or hardened screw-shank nails at maximum fastener spacing as specified by applicable governing codes.
- E. Connections to concrete shall be made with self-tapping screws specially designed for that purpose.
- F. Align floor and ceiling tracks, locating to wall or partition layout. Secure in place with screws or welding at maximum 24" on center. Provide fasteners at corners and ends of track.
- G. Place studs plumb at 16" on center maximum not more than 2" from abutting walls and at each side of openings. Connect studs to tracks using screws or welding in accordance with manufacturer's recommendations. Where stud system abuts column or wall, including masonry, anchor ends of stiffeners to supporting structure.
- H. Construct corners with minimum three studs. Double stud at door, windows, and sidelight jambs. Install intermediate studs above and below openings to match wall stud spacing.
- I. Provide deflection allowance of L/360 below supported horizontal building framing in ceiling or head track for nonload-bearing framing.
- J. Install framing between studs for attachment of electrical boxes and other mechanical and electrical items.
- K. Erect load-bearing studs one piece full length. Splicing and wire tying of framing components is not permitted. Join members forming trusses by welding.
- L. Erect load-bearing studs, brace and reinforce to develop full strength to meet design requirements.

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- M. Make provision for erection stresses. Provide temporary alignment and bracing.
- N. Provide bridging at 1/3 points, or as recommended by manufacturer for loading conditions, whichever is more stringent.
- O. Frame both sides of expansion and control joints with separate studs. Do not bridge joint with any component of wall system, including tracks.
- P. Ensure framing provides true and flat surfaces.

3.02 WELDING:

- A. Where welding is required, use special low amperage welding equipment and small diameter rods to prevent blow holes in material.
- B. Welds shall be 1/8" fillet continuous across contact joint.
- C. Puddle welds shall be 3/4" diameter full fusion. Weld washers shall be used where welds are made to material 3/16" or more thickness.
- D. Use splices or butt welds at joints in runner track. No splices shall be permitted in track over lintels, diaphragm sheathing, or diagonal bracing.

3.03 ADJUSTING:

- A. Touch-up field welds and scratched or damaged galvanizing.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. **WORK INCLUDED:** Provide all miscellaneous metal and metal fabrications, complete, in place, as shown on the Drawings, specified herein, or needed for a complete and proper installation and not specifically called for under other Sections of these Specifications.
- B. **RELATED WORK DESCRIBED ELSEWHERE:**
 - 1. Other metal items are specifically called for and described in other Sections.

1.02 QUALITY ASSURANCE:

- A. **STANDARDS:** Comply with standards specified herein as listed in Section 01085.
- B. **QUALIFICATIONS OF PERSONNEL:** Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. **WELDING:** Perform all shop and field welding required in connection with the work of this Section, adhering strictly to the current pertinent recommendations of the American Welding Society.

1.03 SUBMITTALS:

- A. **GENERAL:** Comply with provisions of Section 01300.
- B. **PRODUCT DATA:**
 - 1. Complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Shop drawings of all items proposed to be furnished and installed under this Section. Include plans, sections, elevations and details as needed.
 - 4. Templates for anchor and bolt installation by other trades.

1.04 PRODUCT HANDLING:

- A. **PROTECTION:** Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. **REPLACEMENTS:** In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS:

2.01 MATERIALS AND COMPONENTS:

- A. **METAL SURFACES, GENERAL:** For fabrication of the work of this Section which will be exposed to view,

use only those materials which are smooth and free from surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness.

B. STANDARDS: All materials shall comply with:

1. Steel plates, shapes, and bars: ASTM A36.
2. Steel plates to be bent or cold formed: ASTM A283, Grade C.
3. Steel tubing, hot-formed, welded, or seamless: ASTM A501.
4. Steel bars and bar-sized shapes: ASTM A306, Grade 65, or ASTM A36.
5. Cold-finished steel bars: ASTM A108, grade as selected by the fabricator.
6. Cold-rolled carbon steel sheets: ASTM A336.
7. Galvanized carbon steel sheets: ASTM A526, with ASTM A525, G90 zinc coating.
8. Stainless steel sheets: Type 302/304 of American Iron and Steel Institute, 24 gauge, with number 4 finish.
9. Gray iron castings: ASTM A48, Class 30.
10. Malleable iron castings: ASTM A47, grade as selected by the fabricator.
11. Steel pipe: ASTM A53, type as selected, Grade A, black finish unless galvanizing is required, standard weight (Schedule 40) unless otherwise indicated.
12. Concrete inserts: Threaded or wedge type, galvanized ferrous castings, either malleable iron ASTM A47 or cast steel ASTM A27. Provide bolts, washers, and shims as required, hot-dip galvanized, ASTM A153.
13. Nonshrink nonferrous grout: CE CRD C588.

2.02 FASTENERS:

A. GENERAL: Provide zinc-coated fasteners for exterior use and where built into exterior walls. Select fasteners for the type, grade, and class required.

B. STANDARDS: All fasteners shall comply with:

1. BOLTS AND NUTS: Regular hexagon-heat type, ASTM A307, Grade A.
2. LAG BOLTS: Square-head type, Fed. Spec. FF-B-561.
3. MACHINE SCREWS: Cadmium plated steel, Fed. Spec. FF-S-92.
4. WOOD SCREWS: Flat-heat carbon steel, Fed. Spec. FF-S-11.
5. PLAIN WASHERS: Round, carbon steel, Fed. Spec. FF-W-92.
6. MASONRY ANCHORAGE DEVICES: Expansion shields, Fed. Spec. FF-S-325.

SECTION 05500
METAL FABRICATIONS

7. TOGGLE BOLTS: Tumble-wing type, Fed. Spec. FF-B-588, type, class, and style as required.
8. LOCK WASHERS: Helical spring type carbon steel, Fed. Spec. FF-W-84.

2.03 PAINT:

- A. METAL PRIMER PAINT:
1. Use mixed pigment, alkyd varnish, linseed oil paint complying with Fed. Spec. TT-P-86, Type II; raw linseed oil, alkyd paint, complying with SSPC Paint 2-64; or basic silico chromate base iron oxide, linseed oil, alkyd paint complying with Fed. Spec. TT-P-615, Type II.
 2. Primer selected shall be compatible with finish coats of paint. Coordinate selection of metal primer with actual finish paint provided under Section 09900 of these specifications.
- B. GALVANIZING REPAIR PAINT: Use a high zinc dust content paint for regalvanizing welds in galvanized steel, complying with MIL SPEC MIL-P-21035.

2.04 FABRICATION:

- A. WORKMANSHIP:
1. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in the finished product.
 2. Work to dimensions shown or accepted on the Shop Drawings, using proven details of fabrication and support.
 3. Use type of materials shown or specified for the various components of the work.
 4. Form exposed work true to line and level, with accurate angles and surfaces and with straight sharp edges.
 5. Ease the exposed edges to a radius of approximately 1/32" unless otherwise shown.
 6. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 7. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
 8. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, use Phillips flat-head (countersunk) screws or bolts.
 9. Provide for anchorage of the type shown. Coordinate with supporting structure. Fabricate and space the anchoring devices to provide adequate support for intended use.
 10. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.
- B. GALVANIZING: Provide a zinc coating for those items shown or specified to be galvanized, as follows:
1. ASTM A153 for galvanizing iron and steel hardware.
 2. ASTM A123 for galvanizing rolled, pressed, and forged steel shapes, plates, bars, and strip (1/8")

thick and heavier.

3. ASTM A39\86 for galvanizing assembled steel products.

C. SHOP PAINTING:

1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise specified.
2. Remove scale, rust, and other deleterious materials before applying shop coat.
3. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 or SSPC-SP-3.
4. Remove oil, grease, and similar contaminants in accordance with SSPC-SP-1.
5. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's recommendations, and at a rate to provide the recommended dry film thickness.
6. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.
7. Apply one shop coat to fabricated metal items; except, apply two shop coats to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first coat.

2.05 MISCELLANEOUS METAL FABRICATIONS:

A. ROUGH HARDWARE:

1. Provide bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete and other structures.
2. Manufacture or fabricate items of sizes, shapes, and dimensions required.
3. Provide malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish steel washers.

B. LOOSE BEARING AND LEVELING PLATES:

1. Provide loose bearing and leveling plates for steel items bearing on concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.
2. Drill plates to receive anchor bolts and for grouting as required.
3. Galvanize after fabrication.

C. MISCELLANEOUS FRAMING AND SUPPORTS:

1. Provide miscellaneous steel framing and supports which are not part of structural steel framework, as required to complete work.
2. Fabricate miscellaneous units to sizes, shapes, or profiles shown; or, if not shown, of required dimensions to receive adjacent other work to be retained by framing.

SECTION 05500
METAL FABRICATIONS

3. Fabricate the miscellaneous units from structural steel shapes, plates, and steel bars of welded construction with mitered joints for field connection, unless otherwise shown.
 4. Cut, drill, and tap units to receive hardware.
 5. Equip units with integrally welded anchors for casting into concrete or building into masonry, and furnish inserts if units must be installed after concrete is placed.
 6. Except as otherwise shown, space anchors (24") on centers, and provide minimum anchor units of (1-1/4"x1/4"x8") steel straps.
 7. Galvanize miscellaneous frames and supports where indicated.
- D. **PIPE BOLLARDS:** 6"Ø steel pipe bollards. (Refer to drawings) 8'-0" long.
- E. **SIDEWALK BOXES:** U.N.O. provide 1/4" thick steel plate x 12" wide x length required and 2 - 1"x1"x3/16" angles x length required. Attach plate to angles with CSK 1/4" flat sheet metal screws at 24" o.c.

PART 3: EXECUTION:

3.01 INSPECTION:

- A. Examine the areas and conditions under which miscellaneous metal items are to be installed, and correct conditions detrimental to timely and proper completion of the Work. Do not proceed until satisfactory conditions are corrected.

3.02 PREPARATION:

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction. Coordinate delivery of such items to project site.

3.03 INSTALLATION:

A. **SETTING LOOSE PLATES:**

1. Clean concrete bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
2. Set loose leveling and bearing plates on wedges, or other adjustable devices.
3. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims; but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
4. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

- B. **FASTENING TO IN-PLACE CONSTRUCTION:** Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrication to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

C. **CUTTING, FITTING, AND PLACEMENT:**

1. Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications.

SECTION 05500
METAL FABRICATIONS

2. Set work accurately in location, alignment, and elevations, and make plumb, level, true, and free from rack, measured from established lines and levels.
 3. Provide temporary bracing or anchors in formwork for items which are to be built into concrete or similar construction.
 4. Fit exposed connections accurately together to form tight hairline joints.
 5. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.
 6. Grind exposed joints smooth, and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
- D. FIELD WELDING: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of weld made, and methods in correcting welding work.
- E. TOUCH-UP PAINTING: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 0.051 mm (2.0 mils).

END OF SECTION

SECTION 05700 – ALUMINUM HANDRAILING AND GATES

PART 1 – GENERAL

1.01 DESCRIPTION

Provide all of the labor, material, and equipment as required to furnish and properly install all of the aluminum handrailing complete and in place where indicated on the project. Handrailing components shall be guaranteed weather resistant and corrosion resistant.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Rough carpentry: Section 06100

1.03 QUALITY CONTROL

- a. Provide complete shop drawings and manufacturer's descriptive literature for Architect's review.
- b. Provide physical samples, minimum 42"h x 48"L, of handrail sections which are indicative of joint connections, corners, gauge, dimension, finish, etc. for Architect's review.

PART 2 – PRODUCTS

2.01 MATERIALS

- a. Decorative Aluminum Handrailing at Pools, Balconies and Stairs

Handrailing and associated components shall be extruded bronze anodized aluminum equal to that product as manufactured by Bowman Distributing Co., Inc. of Harlingen. All components including fasteners, clips, and miscellaneous items shall be corrosion-resistant. The handrail system shall be designed by the manufacturer to resist a horizontal thrust of 50 pounds per lineal foot applied at top of railing. All pickets shall be spaced at maximum 4" on center. Top rail shall be 1 1/2" to 2" wide. Provide bottom rail maximum 2" off floor surface.

Provide minimum 42" high railing with 36" wide self-latching, self closing gates at balconies and patios.

Provide minimum 48" high railing with 36" wide self-latching, self closing gates to comply with NSPI and town of South Padre Island codes at swimming pool and spa areas.

- b. Provide bronze anodized aluminum gates, hardware, and operators at pedestrian and vehicular entries as indicated on drawings.
- c. Provide shop drawings for gates, railings, and all related components.

PART 3 – EXECUTION

3.01 INSTALLATION

- a. All materials shall be installed in accordance with manufacturer's printed instructions.

- b. All miters, splices and saw cuts shall be accurately joined to assure hairline joint gaps. Post hole coredrilling shall be furnished by manufacturer. Grout posts with non-stick grout.

3.02 CLEANUP AND PROTECTION

- a. Cleaning of installed gates and railings shall be done in accordance with manufacture's printed instructions.
- b. Provide protective measures to the handrail installations such that they are not subjected to damage or wear during the duration of the remaining construction period.
- b. Replace all damaged elements with new work.

END OF SECTION 05700 – ALUMINUM RAILS AND FENCES

SECTION 05805

ALUMINUM EXPANSION JOINT COVERS

PART 1 - GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete the ALUMINUM EXPANSION JOINT COVERS 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.

1.02 SUBMITTALS:

A. SAMPLES:

- 1. Submit for approval samples of aluminum expansion joint covers showing construction and finish specified.

B. SHOP DRAWINGS:

- 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each aluminum expansion joint cover.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents/
 - 1. ALUMINUM EXPANSION JOINT COVERS
 - Architectural Art. Mfg., Inc.
 - Balco, Inc.
 - Construction Specialties, Inc.
 - Metalines, Inc.
 - MM Systems Corporation

2.02 MATERIALS:

- A. ALUMINUM EXPANSION JOINT COVERS: Complete with all accessory items, including fasteners, filler strips, gutters, vapor barriers, etc. Cover shall accommodate a 1" to 2" movement.

2.03 COMPONENTS:

- A. FRAME: Extruded aluminum 6063-T5; plate 6061-T6.
- B. FILLER: None
- C. GUTTER: None
- D. FASTENERS: As required for specific installation, substrates, etc.

SECTION 05805
ALUMINUM EXPANSION JOINT COVERS

2.04 TYPES: (ARCHITECTURAL ART MANUFACTURING, INC.) Refer to structural & architectural drawings & provide for each condition.

A.	FLOOR-TO-FLOOR:	A10-20-11
B.	FLOOR-TO-WALL:	A10-40-11
C.	FLOOR-TO-FLOOR:	A10-13-11
D.	WALL-TO-WALL:	H10-51-14
E.	WALL-TO-WALL:	H10-61-14
F.	WALL-TO-CEILING:	G10-68-14
G.	CEILING-TO-CEILING:	G10-71-14
H.	FLOOR-TO-FLOOR	K20-41-11 AT GYMNASIUM

PART 3: EXECUTION:

3.01 INSTALLATION:

- A. Install in exact accordance with the manufacturer's latest published recommendations, requirements, specifications, details, etc.

END OF SECTION

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STRUCTURAL SPECIFICATIONS FOR:
HARLINGEN CONSOLIDATED INDEPENDENT SCHOOL DISTRICT
TREASURE HILLS ELEMENATARY SCHOOL
2018-2019 CLASSROOM ADDITIONS & RENOVATIONS

PREPARED FOR: ROFA ARCHITECTS

SEALED SET
ISSUED: 05-21-2018

SECTION 02466 – DRILLED PIERS
SECTION 03100 – CONCRETE FORMS
SECTION 03200 – CONCRETE REINFORCEMENT
SECTION 03300 – CAST-IN-PLACE CONCRETE
SECTION 04220 – CONCRETE MASONRY UNITS
SECTION 05040 – HOT-DIP GALVANIZING
SECTION 05120 – STRUCTURAL STEEL FRAMING
SECTION 05210 – STEEL JOIST
SECTION 05310 – STEEL DECK
SECTION 05400 – COLD-FORMED METAL FRAMING
SECTION 05510 – METAL STAIRS



SECTION 02466 - DRILLED PIERS

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. Dry-installed underreamed drilled piers.
- B. Related Sections include the following:
 - 1. Division 3 – Section 03300 "Cast-In-Place Concrete" for general structural and building applications of concrete.

1.3 BASIS OF BIDS

- A. Base bids on indicated number of drilled piers; design length from top elevation to bottom of shaft, extended through the bell, as applicable, and diameter of shaft and bell.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings Provide Electronic PDF's: For concrete reinforcement detailing fabricating, bending, and placing.
- C. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Laboratory Test Reports: For evaluation of concrete materials and mix design.
- D. Welding certificates.
- E. Qualification Data: For Drilled Pier Subcontractor and testing agency.
- F. Record drawings at Project closeout according to Division 1 Section "Closeout Procedures."

1.5 QUALITY ASSURANCE

- A. Drilled-Pier Standard: Comply with provisions in ACI 336.1, "Reference Specifications for the Construction of Drilled Piers," unless modified in this Section.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 - 1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.
- C. Welding Standards: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- D. Trial Drilled Pier: Construct trial drilled pier of diameter and depth and at location indicated or, if not indicated, of same diameter and depth as drilled piers located at least three diameters clear of permanent drilled piers, to demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.
 - 1. Excavate shaft and bell, install reinforcement, fill with concrete, and terminate trial drilled pier 30 inches below subgrade and leave in place.
 - 2. Install and remove temporary casings, where required.
 - 3. If Architect or Geotechnical Engineer determine that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.
- E. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
 - 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Site Information: A geotechnical report has been prepared for this Project and is included elsewhere in the Project Manual for information only.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain. Cut bars true to length with ends square and free of burrs.

2.2 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II.
 - 1. Fly Ash Admixture: ASTM C 618, Class C.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, 1-inch maximum aggregate size.
- C. Water: Potable, complying with ASTM C 94/C 94M requirements.
- D. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 3. High-Range, Water-Reducing Admixture: ASTM C 494, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- E. Sand-Cement Grout: Portland cement, ASTM C 150, Type II; clean, natural sand, ASTM C 404; and water to result in grout with a minimum 28-day compressive strength of 1000 psi (6.9 MPa), of consistency required for application.

2.3 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C; or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.

2.4 CONCRETE MIX

- A. Prepare design mixes according to ACI 211.1 and ACI 301 for each type and strength of concrete determined by either laboratory trial mix or field test data bases.
 - 1. Use a qualified testing agency for preparing and reporting proposed mix designs for laboratory trial mix basis.

- B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): **4,000 psi**
 - 2. Minimum Slump: Capable of maintaining the following slump until completion of placement:
 - a. 7 inches (+/- 1 inch).
 - 3. Do not air entrain concrete for drilled piers.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- D. Concrete-mix design adjustments may be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval of proposed changes to concrete-mix proportions.

2.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. Do not add water to concrete mix after mixing.
 - 2. Maintain concrete temperature to not exceed 90 deg F (32 deg C).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.
 - 1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.
 - 2. Obstructions: Removal of unanticipated boulders, concrete, masonry, or other unforeseen obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work, will be paid according to Contract provisions for changes in the Work.

- B. **Classified Excavation:** Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations, as follows:
1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, and underreaming equipment attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
 2. Special excavation includes excavation that requires special equipment or procedures above or below indicated depth of drilled piers where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.
 - a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
 - b. Earth seams, rock fragments, and voids included in rock excavation area will be considered rock for full volume of shaft from initial contact with rock.
 3. **Obstructions:** Removal of unanticipated boulders, concrete, masonry, or other unforeseen obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work, will be paid according to Contract provisions for changes in the Work.
- C. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
 2. Remove water from excavated shafts before concreting.
 3. Excavate rock sockets of dimensions indicated.
 4. Cut series of grooves about perimeter of shaft to height from bottom of shaft, vertical spacing, and dimensions indicated.
- E. Notify and allow Owner's testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
1. Do not excavate shafts deeper than elevations indicated, unless approved by Architect.
 2. Additional authorized excavation will be paid according to Contract provisions for changes in the Work.
- F. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.
- G. **Temporary Casings (Where Required):** Provide watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
- H. Bells: Excavate bells for drilled piers to shape, base thickness and diameter, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before concrete is placed.
 1. Shore bells in unstable soil conditions to preclude cave-in during excavation, inspection, and concreting.
- I. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.
- J. Inspection: Each drilled pier must be inspected and tested by Owner's testing and inspecting agency before placing concrete.
 1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
 2. Notify Architect and testing agency at least 24 hours before excavations are ready for tests and inspections.

3.3 STEEL REINFORCEMENT

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
 - 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.
- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
 - 1. Where concrete cannot be directed down shaft without striking reinforcing, place concrete with chutes, tremies, or pumps.
 - 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
 - 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from hot and cold temperatures that could cause physical damage or reduced strength.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- F. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no greater than 90 deg F (32 deg C).
 - 1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled piers.
- B. A drilled-pier report will be prepared by Owner's testing and inspecting agency for each drilled pier as follows:

1. Actual top and bottom elevations.
 2. Top of rock elevation.
 3. Description of soil materials.
 4. Description, location, and dimensions of obstructions.
 5. Final top centerline location and deviations from requirements.
 6. Variation of shaft from plumb.
 7. Shaft excavating method.
 8. Design and tested bearing capacity of bottom.
 9. Depth of rock socket.
 10. Levelness of bottom and adequacy of cleanout.
 11. Ground-water conditions and water-infiltration rate, depth, and pumping.
 12. Description, diameter, and top and bottom elevations of temporary or permanent casings.
 13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 14. Bell dimensions and variations from original design.
 15. Date and time of starting and completing excavation.
 16. Inspection report.
 17. Position of reinforcing steel.
 18. Concrete placing method, including elevation of consolidation and delays.
 19. Elevation of concrete during removal of casings.
 20. Locations of construction joints.
 21. Remarks, unusual conditions encountered, and deviations from requirements.
 22. Concrete testing results.
- C. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by Owner's testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
1. Bearing Stratum Tests: Owner's testing agency will take undisturbed core samples from drilled-pier bottoms; test each sample for compression, moisture content, and density; and report results and evaluations.
- D. Concrete: Sampling and testing of concrete for quality control may include the following:
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94/C 94M.
 - a. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test, but no fewer than one test for each concrete load.
 - b. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - c. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens, unless field-cured test specimens are required.

- d. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier, but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and one specimen will be retained in reserve for later testing if required.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.
4. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.45 MPa).
5. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
6. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.
7. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.
 - a. Continuous coring of drilled piers may be required, at Contractor's expense, when temporary casings have not been withdrawn within specified time limits or where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

3.6 DISPOSAL OF MATERIALS

- A. Remove surplus excavated material and concrete and legally dispose of it off Owner's property.

END OF SECTION 024660

SECTION 03100 – CONCRETE FORMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Formwork for cast-in-place concrete including shoring, bracing and anchorage.
- B. Openings for other Work.
- C. Release agents and other related form accessories.
- D. Form stripping.

1.2 RELATED SECTION

- A. Section 03200 - Concrete Reinforcement
- B. Section 03300 - Cast-In-Place Concrete

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 347, Recommended Practice for Concrete Formwork.

1.4 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."

1.5 QUALITY ASSURANCE

- A. Grading Rules. Rules of the following associations apply to materials furnished under this Section:
 - 1. Southern Pine Inspection Bureau (SPIB).
 - 2. Western Wood Products Association (WWPA).
- B. Tolerances: Follow ACI 301 (Table 4.3.1).

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 DESIGN CRITERIA

- A. Design, engineering, fabrication, erection, maintenance and removal of formwork shall be responsibility of Contractor.
- B. Construct forms following ACI 318, ACI 347, OSHA, state and local requirements.
- C. Provide forms with sufficient strength to withstand pressures resulting from concrete placement and vibration.
- D. Responsibility for properly bracing and shoring to support subsequent construction loads rests solely with Contractor.
- E. Responsibility for removal of forms at any time before concrete has obtained certified specified design strength rests solely with Contractor.
- F. The Engineer's efforts are aimed at designing a project which will be safe after full completion. The Engineer has no expertise in, and takes no responsibility for, construction means and methods or job Site safety during construction which are exclusively Contractor's responsibility. Processing and/or approving submittals made by Contractor which may contain information related to construction methods or safety issues, or participation in meetings where such issues might be discussed must not be construed as voluntary assumption by Engineer of any responsibility for safety procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS / PRODUCTS

- A. Use forms specified in the general notes of the structural drawings. Provide in largest practical sizes to minimize number of required joints.

2.2 MATERIALS

- A. Wood Form Materials:
 - 1. Reference general structural notes in sheet S1.1 for wood grade requirements.

- B. Preformed Steel Forms: Minimum 16 gauge (0.06"/1.5mm) matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Form Release Agent: Colorless chemical form coating or mineral oil which will not stain concrete or absorb moisture.
- D. Form Ties: Standard coil or snap galvanized adjustable ties with 3/4" diameter plastic cones on exposed surfaces. Provide manufacturer's recessed plugs of gray plastic or concrete to seal tie holes.
- E. Nails, Spikes, Lag Bolts, Through Bolts and Anchorages: Sizes required; of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork.
- B. Verify that dimensions agree with drawings.

3.2 ERECTION / INSTALLATION / APPLICATION

- A. Follow ACI 301 and 347.
- B. Provide forms as follows:
 - 1. Concealed Surfaces: Rough or board form finish left by clean, straight formed lumber.
 - 2. Exposed Surfaces (Typical): Hardboard or plywood lined concrete forms.
- C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over-stressing by construction loads.
- D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping.
- E. Align joints and make watertight. Keep form joints to minimum.
- F. Obtain approval before framing openings in structural members which are not shown.
- G. Provide 1" chamfer strips in exposed exterior corners of beams, girders, columns, walls or foundation forms, around tops of all foundation slabs and elsewhere shown.
- H. Provide temporary ports or openings in formwork required for cleaning out debris, adjusting reinforcing steel and to facilitate inspection.

- I. Coordinate with Work of other Sections which require attachment of components to formwork.
- J. Coat forms with non-staining form release agent. No other coating will be permitted unless specifically approved by Architect.
- K. Inserts, Embedded Parts and Openings:
 - 1. Provide formed openings required for items to be embedded in or passing through concrete Work.
 - 2. Locate and set in place items which will be cast directly into concrete.
 - 3. Coordinate with Work of other Sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, collars, thimbles, ties, sockets, nailing blocks, other inserts and components of other Work.
 - 4. Obtain required setting information before proceeding.
- L. Install accessories following manufacturer's instructions, straight, level and plumb. Ensure items are not disturbed during concrete placement.
- M. Form Removal:
 - 1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
 - 2. Loosen forms carefully. Do not wedge pry bars, hammers or tools against exposed concrete surfaces.
 - 3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- N. Do not construct any masonry walls on concrete floors or walls until concrete has attained its design strength and forms and shoring have been removed.
- O. Terminate embedded form ties 1-1/2" from formed face of concrete. Construct ties so that ends and fasteners can be removed without causing spalling of face of concrete.
- P. Repair form tie holes as follows:
 - 1. Below Grade Surfaces: Fill tie holes with waterproof bituminous mastic to prevent water infiltration.
 - 2. Above Grade Surfaces - Concealed: Fill tie holes with compatible materials flush with adjacent concrete.
 - 3. Above Grade Surfaces - Exposed: Fill tie holes with compatible materials flush with adjacent concrete. Repairs shall blend in inconspicuously with surrounding surfaces. Follow Section 03300.
- Q. Finishes. Follow ACI 301 unless specifically shown otherwise.

3.3 TOLERANCES

- A. Formwork: Follow ACI 301.

3.4 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring and bracing to ensure that Work follows formwork design and that supports, fastenings, wedges, ties and items are secure.

3.5 ADJUSTING AND CLEANING

- A. Clean forms as erection proceeds to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

END OF SECTION 03100

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
- B. Section 04220 - Concrete Masonry Units

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 **5.0 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.
- M. Do not allow the installation of conduit, plumbing or piping within the slab thickness without first requesting authorization from Architectural and Engineer design team.

END OF SECTION 03200

SECTION 03300 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior and exterior plain and reinforced site-placed concrete, vapor retarders, expansion joints, curing compounds and other related accessories.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Anchor bolts.
- B. Reinforcement.
- C. Embed Plates.
- D. Masonry Wall Dowels.

1.3 RELATED SECTIONS

- A. Section 03200 – Concrete Reinforcement.
- B. Section 04220 - Concrete Masonry Units.

1.4 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.

1.5 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."

1.6 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 Third Party Independent Inspector 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.

1.7 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.

1.8 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.

1.9 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.
- B. Place concrete at ambient temperatures between 50° and 95°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

2.1 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. Exception: Use grade size No. 8 masonry core fill.
- C. Admixtures:
 - 1. Mineral Admixtures:
 - a. Fly Ash: ASTM C618 Class C or Class F; maximum 25% fly ash may be used as a cement substitute; 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. Air Entraining Admixtures: ASTM C260.
 - b. 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 be used with Engineer's prior approval.
 - c. 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.

2.2 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. Provide admixtures for entrainment in concrete Work subject to vehicle abrasion or freeze - thaw cycles either during construction or afterwards. AIR ENTRAINED CEMENT IS NOT ACCEPTABLE.
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

a. Drilled Pier Mix (Class 1)

F'c	4,000 psi (28-day compressive strength)
Portland Cement	ASTM C 150 Type II
Fly Ash	ASTM C 618 Class C (Maximum of 25% of cementitious material)
Water/Cementitious Material Ratio	0.60 Maximum
Slump	7" (+/- 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
Air Entrainment	Air entrainment shall not be used for pier concrete
Total Air Content	3% Maximum (by volume)
Concrete Temperature	95°F Maximum

b. Foundation & 2nd Floor Slab Mix (Class 2)

F'c	4,000 psi (28-day compressive strength)
Portland Cement	ASTM C 150 Type II
Fly Ash	ASTM C 618 Class C (Maximum of 25% of cementitious material)
Water/Cementitious Material Ratio	0.60 Maximum
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
Air Entrainment	Air entrainment shall not be used for concrete with exposed steel

	troweled surfaces
Total Air Content	3% Maximum (by volume)
Concrete Temperature	95°F Maximum

c. CMU Grout Fill (Class 3)

F'c	3,000 psi (28-day compressive strength)
Portland Cement	ASTM C 150 Type II
Fly Ash	ASTM C 618 Class C (Maximum of 25% of cementitious material)
Slump	8" to 11" measured from the discharge of the truck
Coarse Aggregate	3/8" maximum with gradation requirements prescribed in Table 2 of ASTM C33 Size No. 8

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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 1: Drilled Pier Mix
 - 2. Class 2: Foundation & 2nd Floor Slab Mix
 - 3. Class 3: CMU Grout Fill
- 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.
- b. Install sawed joints immediately after final finishing to depth of 1-1/2" with Soff-Cut saw.
- c. 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.

3.4 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.
- D. Air Content: ASTM C231.
- E. Slump: ASTM C143.

3.5 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.

3.6 PROTECTION

- A. Protect newly placed concrete from weather and construction traffic damage.

3.7 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°F.
 - 4. Cool water and aggregate to lower temperature of concrete.
 - 5. Cool subgrade and forms by sprinkling 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 04220 – CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete masonry units, lintels, mortar and other related accessories.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Reinforcing steel.
- B. Masonry accessories.

1.3 RELATED SECTIONS

- A. Section 03200 – Concrete Reinforcement.
- B. Section 03300 – Cast-In-Place Concrete.

1.4 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 530, Building Code Requirements for Masonry Structures.
 - 2. 530.1, Specifications for Masonry Structures.
- B. American Society for Testing and Materials (ASTM):
 - 1. C33, Concrete Aggregates.
 - 2. C90, Load-Bearing Concrete Masonry Units.
 - 3. C140, Methods of Testing Concrete Masonry Units.
 - 4. C150, Portland Cement.
 - 5. C331, Lightweight Aggregates for Concrete Masonry Units.
 - 6. C618, Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- C. Portland Cement Association (PCA): Recommended Practices For Laying Concrete Block.

1.5 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."

1.6 SUBMITTALS

- A. Submit: Provide electronic (PDF) copies of all required submittal information.
1. Provide independent test reports following ASTM C140 for sampling and testing of CMU. Test reports shall be dated within six months of start of project. Test reports shall include net area compressive strength, absorption and density results, average width, height and length of each unit, minimum face shell thickness, average face shell thickness, minimum web thickness, average web thickness, and all other test reporting requirements as noted in ASTM C140.
 2. Color samples for precolored units.
 3. Masonry unit assembly components such as horizontal wire reinforcement, control joint material and masonry veneer ties.

1.7 QUALITY ASSURANCE

- A. Follow ACI 530 and 530.1.
- B. Maintain 1 copy of each referenced document at Site.
- C. Manufacturer: Current NCMA member.
- D. Provide units from single manufacturing source to ensure uniform texture for continuous and visually related areas.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver to Site only units properly cured and following these specifications.
- B. Protect masonry units from damage and against moisture and weather, particularly against freezing and thawing. Maintain hollow concrete masonry units in their initial dry state until after they are laid up in wall.
- C. Stack masonry units in dry place, off ground on prepared plank platform and in manner to promote circulation of air through and around block. Protect stacked block by shed roof or tarpaulin arranged to allow for circulation of air around and above stacked block.
- D. Carefully handle masonry units. Do not build units into Work with chipped edges, spalls or other damage to their appearance which would show in finished wall.
- E. Do not store adjacent to materials which can cause staining or discoloration.

1.9 PROJECT CONDITIONS

- A. Do not erect masonry when, in Owner's Engineer's opinion, atmospheric conditions or limited facilities prevent proper setting, bonding and curing.
- B. Protect tops of masonry walls against weather. Use strong, non-staining waterproof membrane secured with metal masonry wall clamps or properly weighted down. Maintain this protection during construction of walls and after their completion, properly anchored, repaired and replaced until tops of walls are covered by Work of others.
- C. Leave necessary openings for passage of pipes, drains, ducts, wires and utility lines. Form chases shown, required or directed. Return and solidly close all openings at completion of Work of other trades. Remove rubbish and sweep out area before closing up any pipe chase, duct space or similar limited access or inaccessible area.
- D. Coordinate with other trades and make provisions that will permit installation of their Work in manner to avoid cutting and patching. Build in items furnished by other trades as Work progresses.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C150 Type 1.
- B. Lime: ASTM C207 Type S.
- C. Pozzolans: ASTM C618.
- D. Aggregates: ASTM D33 normal weight or ASTM C331 lightweight. Provide either normal, medium or light weight units unless shown otherwise.
- E. Mortar: Type S, following ASTM C270 Unit Proportion Requirements using preblended masonry cement.
- F. Integral Water Repellent: ASTM E514 Class E.
 - 1. Approved Product: Grace Construction Products' "Dry-Block" admixture.
- G. Integral Color: Integral color pigment mixed with cement and aggregates during fabrication to match local licensee's color selection(s).

2.2 CONCRETE BLOCK

- A. Hollow Units: ASTM C90 Type I; 1900 psi minimum compressive strength (net).

2.3 FABRICATION:

- A. Follow ACI and NCMA.
- B. Provide the following finishes and colors:
 - 1. Exterior Concrete Block: Manufacturer's regular (smooth) molded finish and precolored during fabrication.
- C. Provide integral water repellent in all exterior concrete block and exterior split face block units.
- D. Provide concrete masonry units with modular dimension; standard units 7-5/8" high, 1'-3-5/8" long and 3/8" less nominal widths or thicknesses shown or required, with permissible variation of 1/16".
- E. Provide special units for 90° corners, bond beams, bullnosed corners, control joint fillers, etc. shown or required.
- F. Cure units minimum 14 days in presence of moist air following ASTM C426.
 - 1. Provide block properly cured to 30% of maximum absorption. Questionable block will be tested and shipment rejected if average moisture content is found to exceed specification limits.
 - 2. Do not build in block with moisture content exceeding specification requirements into Work. Dry block containing excess moisture to acceptable maximum either by further air drying or use of heat before being used.
 - 3. No extension of time for completion will be allowed due to delay cause by failure of Contractor to maintain stored block at acceptable moisture content.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.
- B. Inspect materials for defects before starting installation.
- C. Reject any chipped or broken block. DO NOT BUILD DAMAGED UNITS INTO WORK.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other sections.
- B. Provide temporary bracing during installation of masonry Work. Maintain in place until building structure provides permanent bracing.

3.3 ERECTION / INSTALLATION / APPLICATION

- A. Follow ACI and NCMA.
- B. See Sections under which materials to be installed are furnished for additional installation requirements.
- C. Use thoroughly dry concrete block with sharp, square, unbroken corners and edges and no cracks. DO NOT WET MASONRY UNITS.
- D. Take special care in handling and storage of units for exposed block Work. Do not install chipped or marred block where exposed.
- E. Lay block in running bond with each course lapping block below by 1/2 block unless shown otherwise.
- F. Lay solid block units with full mortar coverage on head and bed joints and hollow block units with face shell bedding on head and bed joints. Mortar hollow block unit web joints in load bearing piers or pilasters, in starting course on footings or solid foundation walls and next to cores grouted solid.
 - 1. Do not shift or tap masonry after mortar has achieved initial set. Remove mortar and replace where adjustments must be made.
 - 2. Buttering corners of joints or excessive furring of mortar joints are not permitted.
- G. Build walls and partitions true to dimension, plumb and square, laid to line in level courses, accurately spaced and coordinated with other Work. Keep individual face units "in plane" with walls rising together. Use double lines in multiple-tier walls with each tier plumb and all units "in plane."
- H. Lay out Work to avoid fractional pieces. Interlock external corners. Set partitions on structural floor slabs before finish floor is laid unless shown otherwise.
- I. Perform required cutting with power equipment which will produce true, straight, clean edges free of chipping and undamaged surfaces. CUTTING WITH HAMMER AND CHISEL WILL NOT BE PERMITTED. Use 100% solid block where webs would be exposed. Minimum length of cut units on exposed Work shall be 1/2 unit.
- J. Cut units accurately to fit around pipes, ducts, openings, structural framing, etc. and slush voids full.
- K. Take particular care to embed conduits and pipes within block without fracturing exposed shells and to fit units around switch, receptacle and other boxes set in walls. Grind and cut units before building in service where electric conduit, outlets, switch boxes and similar items occur.
- L. Fill voids and joints between block and different types of materials with mortar.
- M. Make joints approx. 3/8" wide. Line up joints vertically. Remove burrs with burlap or carpet after tooling.

- N. Neatly tool interior and exterior joints below grade and in exposed masonry firm to slightly concave profile when mortar is thumbprint hard unless shown otherwise. Cut off flush and brush off surplus as Work progresses. Tool vertically then horizontally. Furnish all masons with joint tools of same diameter. Exception: Strike flush interior concealed joints (such as in chases and plenums) or those covered with directly applied finish materials.
- O. Install vertical and horizontal masonry reinforcing where shown. Grout cores solid full length of reinforcing with masonry core grout specified in Section 03300. Maintain position of reinforcing within 1/2" of dimensioned position.
- P. Fill voids receiving anchor bolts, wedge anchors, expansion bolts, etc. solid with masonry grout specified under Section 03300.
- Q. Provide solid masonry bearing surface under lintels, beams, bearing plates, etc. as shown. Provide the following minimum solid bearing (as applicable) if not shown:
 - 1. Lintels: Solid masonry bearing for full thickness of wall by length of bearing plus 8" by 8" high.
 - 2. Beams: Solid masonry bearing for full thickness of wall by length of bearing plus 1'-4" by 2 ft high.
- R. Provide solid masonry for course directly below corbelled masonry walls. Max corbel for each course is 1".
- S. Provide closure, lintels, bond beams, jamb units, sash, corners headers and other special shapes shown or required. Provide standard manufactured sizes or cut full size block for fractional course heights and lengths. Provide sash blocks or other shapes designed to receive specified control joint filler strips.
- T. Provide bullnosed units at exterior corners unless shown otherwise. Field grind to Owner's Engineer's satisfaction all external corners not installed bullnosed.
 - 1. Exception: Provide square cornered blocks at window jambs.
- U. Step back unfinished Work for joining with new Work. Toothing will not be permitted unless specifically approved by Owner's Engineer. Remove loose masonry and mortar and clean thoroughly before new Work is started.
- V. Build in chases, openings, reinforcement, anchors, access doors, lintels, flashings and other items required. Provide centering required to properly support masonry until mortar attains design strength. Build in sleeves except where shown to be installed in other Sections.
- W. Build hollow metal door frames into wall. Plumb and brace. Thoroughly embed frame anchors. Slush frame jambs full with mortar. Allow 1/4" for caulking around frame in exterior walls and 1/8" on interior unless shown otherwise. Rake out joints for caulking.
- X. Fill masonry units solid with mortar 2 cores wide at each door jamb and 1 core wide at each window jamb for full height of opening.

- Y. Hold block down approximately 2" below roof structural members such as beams, joists and roof deck subject to deflection at non-bearing walls.
- Z. Provide control and expansion joints in all block Work. Reference Architectural Contract Drawings for masonry joint locations. Joints spacing shall not exceed 22 ft. on center nor shall a joint be located within two feet of an opening.
- AA. Build in control joint filler strips in control joints as masonry is laid up allowing for caulking on each side of wall. Reference architectural for caulking material. Exception: Do not carry horizontal joint reinforcement through control or expansion joints.
- BB. Maintain lateral support of intersecting masonry non- load bearing walls with wire mesh ties placed across joint between walls and spaced 1'-4" on center vertically.
- CC. Install concealed masonry flashing where shown. Provide clean smooth surfaces set in full mortar bed and cover with full mortar bed. Seal penetrations and joints with mastic.
- DD. Build in exposed sheet metal flashing, expansion joints and reglets occurring in masonry. Cut out mortar joint and set flashing or reglet in new mortar bed in existing construction.
- EE. Build in bond beams grouting full and carefully position reinforcing where shown. Lap rebars a minimum length of 48 bar diameters. Field modify standard units required to receive required reinforcing where bond beam units are not available in specified finish.
- FF. Any masonry Work found deficient in respect to these specifications will require entire wall to be removed and relayed at Contractor's expense.

3.4 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/32".
- B. Maximum Variation From Plane of Wall: 1/4" in 10 feet and 1/2" in 20 feet or more.
- C. Maximum Variation From Plumb: 1/4" per story non-cumulative; 1/2" in 2 stories or more.
- D. Maximum Variation From Level Coursing: 1/8" in 3 feet, 1/4" in 10 feet and 1/2" in 30 feet.
- E. Maximum Variation From Joint Thickness: 1/8" in 3 feet.
- F. Maximum Variation From Cross Sectional Thickness of Walls: 1/4".

3.5 ADJUSTING AND CLEANING

- A. Replace any masonry units which are loose or damaged and repair defective mortar joints. Make these repairs such that evidence of repair is not apparent.

- B. Remove surplus mortar, drippings, splatter, etc. from exterior and interior masonry as Work progresses.
- C. Clean, point & dry brush all exposed Work at end of each working day. Fill holes from line pins and nails.
- D. Point joints to provide a neat uniform appearance. Cut out unrepairable defective joints. Fill solidly with mortar and tool to match adjacent Work. DO NOT CORRECT IMPERFECTIONS WITH SPACKLE.
- E. Thoroughly rub out exposed Work to remove any projections. Fill indentations flush with surface.
- F. Clean masonry surfaces upon completion from top down with water and fiber brushes to remove stains. ACID CLEANING OF MASONRY IS NOT PERMITTED.

END OF SECTION 04220

SECTION 05040 – HOT-DIP GALVANIZING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Hot-dip galvanizing of iron and steel materials

1.2 RELATED WORK

- A. Steel materials, fabrications and assemblies are specified to be furnished and installed in various other sections

1.3 REFERENCES

- A. Publications

- 1. American Galvanizers Association (AGA):
 - a. Inspection of Products Hot-dip Galvanized After Fabrication
 - b. The Design of Products to be Hot-dip Galvanized After Fabrication
 - c. Recommended Details of Galvanized Structures
 - d. Quality Assurance Manual
- 2. Research Council on Structural Connections of the Engineering Foundation:
 - a. Specification for Structural Joints Using ASTM A 325 or A 490 bolts.

- B. Reference standards

- 1. American Society for Testing and Materials (ASTM):
 - a. A 123 / A 123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. A 143 Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
 - c. A 153 / A 153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - d. A 384 Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
 - e. A 385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
 - f. A 767 / A 767M Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
 - g. A 780 Repair of Damaged Hot-Dip Galvanized Coatings
 - h. B 6 Specification for Zinc

- i. D 6386 Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
 - j. E 376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
- 2. Federal specifications
 - a. DOD-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair
 - b. MIL-P-26915 Primer Coating, Zinc Dust Pigmented

1.4 QUALITY ASSURANCE

- A. Coating applicator: Company specializing in hot-dip galvanizing after fabrication and following the procedures in the Quality Assurance Manual of the American Galvanizers Association.
- B. Coordination Between Fabricator and Galvanizer: Prior to fabrication, fabricators shall submit approved fabrication shop drawings to the galvanizer. The Galvanizer shall review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required fabrication modifications.
- C. Materials: For steel to be hot-dip galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25%, phosphorous below 0.04%, manganese below 1.3%, and silicon below 0.04%. Notify the galvanizer if steel does not meet these requirements so that suitability for galvanizing may be determined and whether special processing techniques are required.

1.5 DELIVERY, STORAGE & HANDLING

- A. Load and store galvanized articles in accordance with accepted industry standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE COATING APPLICATORS

- A. Members of the AGA or equal approved by the architect and/or engineer.

2.2 STEEL MATERIALS

- A. Material for galvanizing to be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications and assemblies.
- B. Recommended steel materials for hot-dip galvanizing include but are not limited to:
 - 1. Structural shapes and plates: ASTM A 36, A 242 type 2, A 283, A 441, A 500, A 501, A 529, A 572, A 588 and A 992.

2. Steel for fasteners:

General Category	Bolt Material	Nut Material
Carbon Steel	A 307 Gr A or B	A 563 Gr A
High-strength	A 325 Type 1	A 563 Gr DH
Tower Bolts	A 394	A 563 Gr A
Quenched & Tempered (<i>Carbon Steel Bolts</i>)	A 499	A 563 Gr C
Quenched & Tempered (<i>Alloy Steel Bolts</i>)	A 354 Gr BC	A 563 Gr DH

3. Steel for sheet metal articles: ASTM A 569 or A 570.
4. Steel for pipe or tubing: ASTM A 53, A 120 or A 595, Gr A or B.

2.3 FABRICATION REQUIREMENTS

- A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures.
- B. Fabrication practices for products to be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques that could cause steel distortion or embrittlement.
- C. The fabricator shall consult with architect/engineer and hot-dip galvanizer regarding potential concerns, including handling issues, during the galvanizing process that may require design modification before fabrication proceeds.
- D. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
- E. Provide holes and/or lifting lugs to allow for handling during galvanizing.
- F. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil, paint and other deleterious material prior to fabrication.
- G. Remove by blast-cleaning, or other methods, surface contaminants and coatings that are not removable by the normal chemical cleaning process in the galvanizing operation.
- H. Whenever possible, slip joints should be used to minimize field welding of material.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Pre-clean steel work in accordance with accepted methods to produce an acceptable surface for quality hot-dip galvanizing.

3.2 COATING APPLICATION

- A. Galvanize steel members, fabrications and assemblies after fabrication by the hot-dip process in accordance with ASTM A 123 / 123M.
- B. Galvanize bolts, nuts, washers and iron and steel hardware components in accordance with ASTM A 153 / 153M.
- C. Safeguard products against steel embrittlement in conformance with ASTM A 143.
- D. Galvanize reinforcing steel in accordance with ASTM A 767.
- E. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3.3 COATING REQUIREMENTS

- A. Conform to paragraph 6.1 of ASTM A 123 / 123M, Table 1 of ASTM A 153 / 153M, or Table 2 of A 767, as appropriate.
- B. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- C. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

3.4 TESTS

- A. Inspection and testing of hot-dip galvanized coatings shall be done under the guidelines provided in the AGA publication Inspection of Products Hot-dip Galvanized After Fabrication.
- B. Include visual examination and tests in accordance with ASTM A 123 / 123M, A 153 / 153M, or A 767, as applicable, to determine the thickness of the zinc coating on the metal surface.
- C. If requested by owner or architect/engineer, the steel fabricator shall be prepared to furnish notarized Certificate of Compliance with ASTM standards and specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

3.5 REPAIR OF DAMAGED COATING

- A. The maximum area to be repaired is defined in accordance with ASTM A 123 / 123M, Section 6.2, current edition.

1. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.
- B. Repair areas damaged by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in ASTM A 123 / 123M, Section 6.2, current edition.

END OF SECTION 05040

SECTION 05120 - STRUCTURAL STEEL FRAMING

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 ALLOWANCE

- A. Include in bid a lump sum allowance for additional structural steel materials (fabricated and installed) required to complete the Work equal to **5.0 tons** of structural steel. Any unused tonnage will be credited to Owner at a cost of **\$4,000.00 per ton**.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Architecturally exposed structural steel.
 - 3. Grout.
- B. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Steel Deck" for field installation of shear connectors.
 - 3. Reference Architectural specifications for surface preparation and priming requirements.

1.4 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.
- B. Architecturally Exposed Structural Steel: Structural steel designated as architecturally exposed structural steel in the Contract Documents.

1.5 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. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned bolted connections.
 5. For structural steel connections indicated to comply with design loads, include structural analysis data signed and sealed by a the qualified professional engineer responsible for their preparations.
- C. Welding certificates.
- D. Qualification Data: For Installer and fabricator.
- E. Mill Test Reports: Submit mill test reports upon request by project engineer. Mill test reports shall be signed by manufacturers certifying that the following products comply with requirements:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Tension-control, high-strength bolt-nut-washer assemblies.
 5. Shear stud connectors.
 6. Shop primers.
 7. Nonshrink grout.
- F. Source quality-control test 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 general contractor'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 general contractor'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: Qualify procedures and personnel according to AWS D1.1, "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--Allowable Stress Design and Plastic Design."
 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Mockups: Build mockups of architecturally exposed structural steel to set quality standards for fabrication and installation.
1. Coordinate finish painting requirements with Division 9 painting Sections.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M, ASTM A 572/A 572M, Grade 50 (345).
- B. Channels, Angles Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M for general use, and ASTM A 572/A 572M, Grade 50 (345) for metal building built-up plate section members.

- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: As indicated on structural drawings.
 - 2. Finish: Primed.
- F. 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;
 - 1. Finish: Plain
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8,) compressible-washer type.
 - a. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; 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.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - 5. Finish: Plain.
- E. Headed Anchor Rods: ASTM F 1554, Grade 36 straight.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - 4. Finish: Plain.
- F. Threaded Rods: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6).
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy hex carbon steel.
 - 2. Washers: ASTM F 436 (ASTM F 436M) hardened and ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.

- G. Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.
- H. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.
- I. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

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: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
 - 1. SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

2.4 GROUT

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, 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's Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design.
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
 - 5. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.

6. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning"
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

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 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

- a. Grind butt welds flush.
- b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

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.
 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 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 dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.8 SOURCE QUALITY CONTROL

- A. 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 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.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".

- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 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 base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing 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 and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 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.

- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 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: Shop-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.
1. In addition to visual inspection, field welds may be tested according to AWS D1.1 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.

3.6 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 and accessories, bearing plates, and abutting structural steel.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

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. LH Joists
5. 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. Design:
 1. Joist shall be designed to meet SJI load table for specified joist sections and spans.
 2. Joist shall be designed to meet additional uplift and concentrated loads as specified in contract structural drawings.
- B. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- C. 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.
 3. Special Joists: Reference drawings for specific deflection criteria.

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 AND LH-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to Standard Specifications for Open Web Steel Joists, K-Series and LH-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.
 - 2. Joist Type: LH-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 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. 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. Provide electronic (PDF) copies of all required submittal information.
- B. Select deck categories from options in paragraph below.
- C. Comply with SDI Publication No. 29, "Specifications and Commentary for Steel Roof Deck
- D. 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: $F_y = 33$ 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: $F_y = 60$ KSI
- 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.
- J. Do not start installation of metal decking until corresponding steel framework has been plumbed, aligned and completed and until temporary shoring, where required, has been installed. Remove any oil, dirt, paint, ice, water and rust from steel surfaces to which metal decking will be welded.
- K. Do not use roof deck units for storage or working platforms until permanently secured. Do not overload deck units once placed. Replace any deck units that become damaged after erection at no cost to the Owner.
- L. Provide steel decking in sufficient lengths to extend over 3 or more spans, except where structural steel layout does not permit.
- M. Welding to conform to AWS D1.3 and done by competent experienced welding mechanics.
- N. Areas scarred during erection and welds shall be thoroughly cleaned and touched up with zinc rich galvanizing repair paint.
- O. Provide metal concrete stops at edges of deck as required.
- P. Cutting and Fitting:
 - 1. Cut all metal deck units to proper length in the shop prior to shipping.
 - 2. Field cutting by the metal deck erector is restricted to bevel cuts, notching to fit around columns and similar items, and cutting openings that are located and dimensioned on the structural drawings.
 - 3. Other penetrations shown on the approved metal deck shop drawings but not shown on the structural drawings are to be located, cut and reinforced by the trade requiring the opening.
 - 4. Make all cuts neat and trim using a metal saw, drill or punchout device; cutting with torches is expressly prohibited.
 - 5. Do not make any cuts in the metal deck that are not shown on the approved metal deck drawings. If an additional opening not shown on the approved shop drawings is required, submit a sketch, to scale, locating the required new opening and any other openings and supports in the immediate area. Do not cut the opening until the sketch has been reviewed and accepted by the Engineer. Provide any additional reinforcing or framing required for the opening at no cost to the Owner. Failure to comply with these requirements is cause for rejection of the work and removal and replacement of the affected metal deck.
 - 6. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work shown.

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. 3.5/8 inch, 16 ga studs
 - a. Minimum Base-Metal Thickness: 0.0566 inch
 - b. Flange Width: 1-5/8 inches
 - c. Section Properties: 3.5/8" Studs minimum $I_x = 0.873 \text{ in}^4$; $S_x = 0.482 \text{ in}^3$
- 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 Slide Clip (FCSC 3.1/2" and 5.1/2")
 - b. Exterior Head of Wall: Clark Dietrich, Inc. Fast Clip Top Clip (FTC3 and FTC 5).
 - 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 05510 – 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 14 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 05510

SECTION 06010

LUMBER

PART 1 - GENERAL:

1.1 DESCRIPTION:

- A. **WORK INCLUDED:** Provide all wood, nails, bolts, screws, framing anchors, and other rough hardware, and all other items needed for rough and finished carpentry in this Work but not specifically described in other Sections of these Specifications.
- B. **RELATED WORK DESCRIBED ELSEWHERE:**
 - 1. **FORM LUMBER:** SECTION 03100
 - 2. **ARCHITECTURAL WOODWORK:** SECTION 06400

1.2 QUALITY ASSURANCE:

- A. **STANDARDS:** Comply with all pertinent codes and regulations, and with the standards listed in this Section as described in Section 01085.
- B. **CONFLICTING REQUIREMENTS:** In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.3 SUBMITTALS:

- A. Make all proposals for substitution in strict accordance with the provisions of Section 01300 of these Specifications.

1.4 PRODUCT HANDLING:

- A. **PROTECTION:**
 - 1. Use all means necessary to protect lumber materials before, during, and after delivery to the job site, and to protect the installed work and materials of all other trades.
 - 2. Deliver the materials to the job site and store, all in a safe area, out of the way of traffic, and shored up off the ground surface.
 - 3. Identify all framing lumber as to grades, and store all grades separately from the other grades.
 - 4. Protect all metal products with adequate waterproof outer wrappings.
 - 5. Use extreme care in the off-loading of lumber to prevent damage, splitting, and breaking of materials.
- B. **REPLACEMENTS:** In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.1 GRADE STAMPS:

- A. **FRAMING LUMBER:** Identify all framing lumber by the grade stamp of the West Cost Lumber Inspection Bureau.
- B. **PLYWOOD:** Identify all plywood as to species, grade, and glue type by the stamp of the American Plywood Association.
- C. **OTHER:** Identify all other materials of this Section by the appropriate stamp of the agency listed in the reference standards, or by such other means as are approved by the Architect.

2.2 MATERIALS:

- A. All materials, unless otherwise specifically approved in advance by the Architect, shall meet or exceed the following:

SECTION 06010
LUMBER

<u>ITEM:</u>	<u>DESCRIPTION:</u>
STUDS:	Yellow pine fir, stud grade, Douglas Fir- Hemlock, stud grade
POSTS AND BEAMS:	Douglas Fir, Structural Number 1
ALL OTHER HORIZONTAL FRAMING MEMBERS:	Douglas Fir-Hemlock, Construction Grade
ALL OTHER VERTICAL FRAMING MEMBERS:	Douglas Fir-Hemlock, Standard or better grade
PLYWOOD: Concealed Sheathing:	Standard interior-grade with exterior glue
EXTERIOR WOOD TRIM:	Redwood or Cedar, Select Heart Grade, Smooth
INTERIOR WOOD TRIM: Base:	White Pine, ½" by 1 7/8", reversible, fingerjointed acceptable.
Door & Window Casing:	White Pine, 5/8 by 1 5/8", beveled casing, finger-jointed acceptable.
CLOSET SHELVES:	White Pine, 1"X12", Number 2 or better, on 1"x4" White Pine cleats continuous 3 sides, or as shown on the Drawings in 3/4" plywood.
WOOD PRESERVATIVE:	Ammoniacal copper arsenite, or 5% solution of pentachlorophenol.
STEEL HARDWARE:	ASTM A7 or A36 (use galvanized at exterior locations).
MACHINE BOLTS:	ASTM A307
LAG BOLTS:	FED. SPEC. FF-B-561
NAILS:	Common (except on noted), Fed. Spec. FF-N-1-1 (use galvanized at exterior locations)

2.3 OTHER MATERIALS:

- A. All other materials, not specifically described but required for a complete and proper installation as indicated on the Drawings, shall be new, suitable for intended use, and subject to the approval of the Architect.

PART 3: EXECUTION

3.1 DELIVERIES:

- A. STOCKPILING: Stockpile all materials sufficiently in advance of need to ensure their availability in a timely manner for this work.
- B. DELIVERY SCHEDULE: Make as many trips to the job site as are necessary to deliver all materials of this Section in a timely manner to ensure orderly progress of the total work.
- C. COMPLIANCE: Do not permit materials not complying with the provisions of this Section of these Specifications to be brought onto or to be stored at the job site. Immediately remove from the job site all non-complying materials and replace them with materials meeting the requirements of this Section.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. WORK INCLUDED: Provide all wood framing indicated on the Drawings or required for a complete and operable facility.
- B. RELATED WORK DESCRIBED ELSEWHERE:
 - 1. CONCRETE FORMWORK: SECTION 03100
 - 2. LUMBER: SECTION 06010
 - 3. INSTALLATION OF WOOD DOORS/FRAMES: SECTION 06200

1.02 QUALITY ASSURANCE:

- A. QUALIFICATIONS OF WORKMEN: Provide sufficient workmen and supervisors who shall be present at all times during execution of this portion of the Work, and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- B. REJECTION: In the acceptance or rejection of rough carpentry, the Architect will make no allowance for lack of skill on the part of the workmen.

1.03 PRODUCT HANDLING:

- A. PROTECTION:
 - 1. Store all materials in such a manner as to ensure proper ventilation and drainage, and to protect against damage and the weather.
 - 2. Keep all materials clearly identified with all grade marks legible. Keep all damaged material clearly identified as damaged, and store separately to prevent its inadvertent use.
 - 3. Do not allow installation of damaged or otherwise non-complying material.
 - 4. Use all means necessary to protect the installed work and materials of all other trades.
- B. REPLACEMENTS: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 (NO PRODUCTS ARE REQUIRED IN THIS SECTION)

PART 3: EXECUTION

3.01 INSPECTION:

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 WORKMANSHIP:

- A. GENERAL: All rough carpentry shall produce joints true, tight, and well nailed, with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.
- B. SELECTION OF LUMBER PIECES:
 - 1. Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making connections.
 - 2. Cut and discard all defects which will render a piece unable to serve its intended function. Lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.
 - 3. SHIMMING: Do not shim sills, joists, short studs, trimmers, headers, lintels, or other framing components.

3.03 WOOD TREATMENTS:

- A. Treat all blocking and framing lumber, and other wood members used in contact with concrete, masonry, plaster, or other damp material, and all exterior members including roof blocking in accordance with AWPA.
 - 1. Reduce moisture content to 19% or less after treatment for members which will be painted.
 - 2. Brush coat surfaces that have been cut after treatment.
 - 3. Approved Material: KOPPERS "WOLMANIZED" or OSMOSE "K-33".
- B. Treat members indicated as "Fire-Retardant" with Koppers "Non-Com" or Osmose "Flameproof". (All members within the building including framing members above the ceiling).
 - 1. Reduce moisture content to 19% or less after treatment.
 - 2. Each piece shall bear UL label for flame spread of 25 or less.
 - 3. Reduce moisture content to 12% or less after treatment for members which will be painted.

3.04 GENERAL FRAMING:

- A. GENERAL:
 - 1. In addition to all framing operations normal to fabrication and erection indicated on the Drawings, install all backing and blocking required for work of other trades.
 - 2. Set all horizontal or sloped members with crown up.
 - 3. Do not notch, bore, or cut members for pipes, ducts, conduits, or other reasons except as shown on the Drawings or as specifically approved in advance by the Architect.
- B. BEARINGS:
 - 1. Make all bearings full unless otherwise indicated on the Drawings.
 - 2. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support. Where framing members slope, cut or notch the ends as required to give uniform bearing surface.

3.05 BLOCKING AND BRIDGING:

- A. BLOCKING:
 - 1. Install all blocking required to support all items of finish and to cut off all concealed draft openings, both vertical and horizontal, between ceiling and floor areas.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. **WORK INCLUDED:** Provide all finish carpentry needed for a complete and proper installation including, but not necessarily limited to:
1. Fitting and installing all wood doors.
 2. Installing all finish hardware.
- B. **RELATED WORK DESCRIBED ELSEWHERE:**
- | | |
|--------------------------------|---------------|
| 1. Architectural Woodwork: | SECTION 06400 |
| 2. Furnishing Wood Doors: | SECTION 08210 |
| 3. Furnishing Finish Hardware: | SECTION 08710 |

1.02 QUALITY ASSURANCE:

- A. **STANDARDS:** Comply with standards specified herein as listed in Section 01085.
- B. **QUALIFICATIONS OF PERSONNEL:**
1. Throughout progress of the work of this Section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this Section.
 2. In actual installation of the work of this Section, use adequate numbers of skilled workmen to ensure installation in strict accordance with the approved design and the approved recommendations of the materials manufacturers.
- C. **QUALIFICATIONS OF FINISH HARDWARE ADJUSTER:** Provide the services of an AHC member of the Door and Window Institute, or an equally qualified individual approved in advance by the Architect, who shall inspect, adjust, and report to the Architect as described in Part Three of this Section.

1.03 PRODUCT HANDLING:

- A. **PROTECTION:** Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the work and materials of all other trades.
- B. **REPLACEMENTS:** In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 FASTENERS:

- A. Provide fasteners properly selected for the material to be fastened and the substrate to which the material will be fixed, designed to develop proper and adequate strength commensurate with the use.

PART 3: EXECUTION

3.01 INSPECTION:

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until satisfactory conditions have been corrected.

3.02 INSTALLATION OF WOOD DOORS:

- A. Initial Inspection of Doors: Prior to start of installation of each door, carefully inspect the door and verify:
1. That the door furnished is the proper door for the opening, as described on the Door Schedule in the Drawings.
 2. That the door is in sound condition, unblemished, without warp, twist, bow, or other attributes causing it to be rejected upon installation.
- B. HANDLING: Carry wood doors, do not drag them. Use extreme care in handling to prevent damage.
- C. FITTING: Trim all wood doors as necessary to provide a uniform clearance of between 3 mm (1/8") and 5 mm (3/16") at jambs and head, and a uniform clearance at the threshold or floor to properly clear the floor covering described on the Finish Schedule in the Drawings.
- D. INSTALLING: For each door, verify the hardware type as described on the Door Schedule in the Drawings and verify that hardware actually supplies is the hardware specified. Use only the specified hinges or butts, and the proper equipment for the purpose, install the door into the opening with the following hinge or butt locations throughout the work:
1. TOP HINGE OR BUTT: The center of the hinge or butt not more than 28 cm (11") below the top of the door;
 2. BOTTOM HINGE OR BUTT: The center of the hinge or butt not more than 33 cm (13") above the finish floor;
 3. INTERMEDIATE HINGE, BUTT, Equidistant between the top and OR PIVOT: bottom hinge, butt, or pivot.
- E. FINISHING:
1. With fine sandpaper, working only in direction of the grain of the wood, remove all rough edges resulting from door trimming and leave the installed door in condition to receive its final finish.
 2. Carefully touch-up all trimmed surfaces, applying a finish equal in all respects to the factory-prefinish specified in Section 08210.

3.03 INSTALLATION OF OTHER FINISH HARDWARE:

- A. LOCATIONS: Using only the specified finish hardware, and the proper equipment for the purpose, install all other finish hardware in the following locations throughout the work:
1. ARMOR PLATES: On the push side of single-acting doors, and on both sides of double-acting doors;
 2. COMBINATION PUSH-AND-PULL PLATES: Centered 102.4 cm (40-5/16") above the finish floor;
 3. DOOR PULL ON PLATES: Centered 102.4 cm (40-5/16") above the finish floor;
 4. DOOR PULLS, SECTIONAL: Centered 102.4 cm (40-5/16") above the finish floor;
 5. DOOR-CLOSING DEVICES: Install and adjust in strict accordance with the templates and printed instructions supplied by the manufacturer of

SECTION 06200
FINISH CARPENTRY

- the devices. Insofar as practicable, doors opening to or from halls or corridors shall have the closer mounted on the room side of the door.
- | | |
|--|--|
| 6. EXTENSION LEVER FLUSH BOLTS: | In the edge of the door. Center to bolt fronts 30 cm (12") from bottom and 30 cm (12") from top edge of the door; |
| 7. FLUSH CUP PULLS: | Centered 102.4 cm (40-5/16") above the finish floor; |
| 8. KEY CABINET: | Install where directed. |
| 9. KICK PLATES: | On single-acting doors; with kick plate on push side. On double-acting doors; with kick plate on both sides. |
| 10. MORTISE DEADLOCK STRIKE: | Center 152.4 cm (60") above the finish floor; |
| 11. KNOB LOCK AND KNOB LATCH STRIKE: | Center 102.4 (40-5/16") above the finish floor; |
| 12. ROLLER LATCH STRIKES: | Center 102.4 cm (40-5/16") above the finish floor; |
| 13. PANIC BOLT CROSS BARS: | Align in horizontal position with top and bottom bolts and rods aligned vertically. Install the centerline of strike 102.4 cm (40-5/16") above the finish floor; |
| 14. PUSH BARS, SINGLE: | Centered 106.7 cm (42") above the finished floor; |
| 15. PUSH BARS, TYPE 476: | Centered 106.7 cm (42") above the finished floor; |
| 16. PUSH PLATES: | Centered 121.9 cm (48") above the finished floor; |
| 17. ROLLER BUMPERS: | Install at the top of the door near the edge of the lock stile. |
| 18. OTHER HARDWARE ITEMS, NOT DESCRIBED ABOVE: | Install as directed. |
- B. ANCHORING: Anchor all components firmly into position for long life under hard use. Use only the anchoring devices furnished with the hardware item, unless otherwise specifically directed.

3.04 INSPECTION, ADJUSTMENT, AND REPORTING:

- A. GENERAL: Using the personnel described in Paragraph 1.2C of this Section, inspect each of installed finish hardware. Verify that each such item has been installed in strict accordance with the manufacturer's recommendations, is in proper condition, and functions in its intended manner.
- B. ADJUSTMENT: On all finish hardware items designed to permit adjustment, submit a written report stating:
1. That all installed finish hardware has been inspected in accordance with this Article;
 2. That all installed finish hardware is in accordance with these specifications as to quality, type, appearance, operation, and all other specified attributes;
 3. A precise list, by door opening number and hardware item, of all items of finish hardware which do not meet the specified requirements in furnishing, installation, or both.

END OF SECTION

SECTION 06240

LAMINATED PLASTIC

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. WORK INCLUDED: Provide all laminated plastic, complete, in place, as shown on the Drawings, specified herein, and needed for a complete and proper installation:
- B. RELATED WORK DESCRIBED ELSEWHERE:
 - 1. Architectural Woodwork: SECTION 06400

1.02 QUALITY ASSURANCE:

- A. STANDARDS: Comply with standards specified herein as listed in Section 01085.
- B. QUALIFICATIONS OF MANUFACTURERS: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

1.03 SUBMITTALS:

- A. PRODUCT DATA:
 - 1. Complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with the specified requirements.
 - 3. Samples of the full range of colors and patterns available in each of the specified grades from the proposed manufacturer.
 - 4. Manufacturer's recommended installation procedures.

The manufacturer's recommended installation procedures, when approved by the Architect, will become the basis for inspection and accepting or rejecting actual installation procedures used on the work.

1.04 PRODUCT HANDLING:

- A. PROTECTION: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the work and materials of all other trades.
- B. REPLACEMENTS: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

- A. GENERAL: All plastic laminate shall be general purpose, "post-forming", or "specific purpose" type as recommended by the Contractor and approved by the Architect for use on the various surfaces, and shall be "high wear" type finish in accordance with provisions of NEMA LD3. (WILSONART, or equal).
- B. COLORS AND PATTERNS: All colors shall be as selected by the Architect from the standard colors and patterns of the approved manufacturer.

2.01 ADHESIVES:

For installation of plastic laminates, use only "rigid set" (urea-resin) or "semi-rigid set" (PVC acetate) adhesives. Do not use so-called "contact" adhesives.

PART 3: EXECUTION

3.01 INSTALLATION:

Install the approved plastic laminates in strict accordance with the manufacturer's recommendations as approved by the Architect.

END OF SECTION

SECTION 06400

ARCHITECTURAL WOODWORK

PART 1: GENERAL:

1.01 PROJECT DESCRIPTION:

- A. Work Included: Provide all architectural woodwork shown on the Drawings, complete in place, as specified herein.
- B. Related work described elsewhere:
 - 1. Laminated Plastic: SECTION 06240

1.02 QUALITY ASSURANCE:

- A. Standards: Comply with standards specified herein as listed in Section 01085.
- B. Qualifications of Manufacturer: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.
- C. Qualifications of Installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods for proper performance of the work of this Section.
- D. Certification: In addition to complying with all pertinent codes and regulations, comply with the "Architectural Woodwork Institute", latest edition for the grades specified, and provide certification on shop drawings and on each item of architectural woodwork signifying such compliance.

1.03 SUBMITTALS:

- A. General: Comply with all provisions of Section 01300.
- B. Product Data:
 - 1. Complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. Sufficient other data to demonstrate compliance with the specified requirements.
 - 3. Shop drawings showing each of the items to be provided under this Section, completely detailing joinery and other construction, including anchorage, and displaying the "Certificate of Compliance" of the Woodwork Institute for the grades specified.
 - 4. Samples of the proposed woods to be used.
 - 5. Manufacturer's recommended installation procedure.

The manufacturer's recommended installation procedures, as approved by the Architect, will become the basis for inspecting and accepting or rejecting actual installation procedures actually used on the work.

1.04 PRODUCT HANDLING:

- A. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect the installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 CABINETS:

- A. General: Fabricate the cabinets and countertops to the dimensions and arrangements shown on the Drawings, and according to the requirements of this Section. Use of particle board is not permitted under any circumstances. Countertop Material: 3/4" exterior grade hardwood faced plywood, all cabinets.
- B. Grades:
1. All cabinet material that is to be plastic-clad; 3/4" hardwood-faced plywood.
 2. All other cabinet material; "Premium or Select Grade", natural finish, suitable for transparent finish.
- C. Species:
1. All cabinet material that is to be plastic-clad: Standard of the mill for the grade specified.
 2. All other cabinets: Birch veneered plywood. 1/4" x 3/4", solid birch EB6ES to match birch veneered plywood to take transparent finish to match as close as possible.
- D. Countertops:
1. All tops and edges (and back and end splashes where shown) shall be laminated plastic countertops. Comply with provisions of Section 06240, as manufactured by WILSONART Division of Ralph Wilson Plastics, or an equal approved by the Architect.
- E. Finish Hardware: Provide and factory install all required finish hardware.
- F. Millwork Hardware:
1. EACH DRAWER SHALL HAVE:

HARDWARE ITEMS (unless indicated otherwise in the Drawings)

- | | | |
|----|--|--|
| a. | SHELF STANDARDS: | KNAPE & VOGT. #255 x 646 and 87 x 646 |
| b. | SHELF BRACKETS: | K & V 256 & 646 and 187 x 646 x 14" |
| c. | EUROPEAN HINGES: | Grass Nexis #3803 |
| d. | CABINET PULLS: | STANLEY #4478 X 628 |
| e. | MAGNETIC CATCHES: | K & V #1300 x 603
STANLEY #46 X 628 |
| f. | DRAWER SLIDES: | K & V #1300 x 603 |
| g. | LOCKS: | NATIONAL LOCK #MZ-3704-831 with sleeve
#M5-0405. Provide for doors and drawers.
Solid wood stiles at all lock locations. |
| h. | HANGER RODS: | |
| | 1. TUBING: | K & V #770-5CHR |
| | 2. END FLANGES: | K & V #764-CHR |
| | 3. ADJUSTABLE HANGER: | K & V #1195 |
| i. | SLIDING GLASS DOORS: | K & V #1093 top & Bottom Channels
K & V #1085 vinyl guides
K & V #963 ratchet lock for 1/4" glass |
| j. | SHELVES: | |
| | 1. Width and length of shelves as indicated on drawings. | |
| | 2. Clothes rod: | K & V #1 1/16" diameter 660 stainless steel. |
| | 3. Clothes rod support: | K & V #760 anchrome to be cut as noted on drawings. |
| | 4. Shelf brackets: | K & V #208 series titanium finish size as required. |

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ARCHITECTURAL WOODWORK

- G. All millwork shall conform to the AMERICAN WOODWORK INSTITUTE.
- H. Unless otherwise indicated on Drawings shelves shall be 1" x 8" Birch solid wood finished natural where exposed in a room; or, 1" x 8" Pine painted where located in a closet or storage room.

END OF SECTION

SECTION 06610

ACRYLIC RESIN COUNTERTOPS

PART 1 - GENERAL:

1.1 SCOPE:

- A. Perform all work required to complete the ACRYLIC RESIN COUNTERTOPS and trim as indicated by the Contract Documents and furnish all supplementary items necessary for its 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.

1.2 SUBMITTALS:

- A. SAMPLES:
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents:

1. SOLID SURFACING FORMICA	4. WILSONART
2. CORIAN	5. GIBRALTAR
3. ARRAY SOLID SURFACING	6. LG HAUSYS OF AMERICA

2.02 MATERIALS:

- A. Product should have the following characteristics:

Impact resistance:	Should be able to resist fracture, chipping, and cracking better than marble, stone products.
Stain resistance:	Should resist stains. Should be unaffected by food stains, disinfectants, and stains from marking pens should be easily removed.
- B. Material should be homogenous, not coated or laminated, and have a consistent color throughout.
- C. Material should be able to be bonded in a seemingly seamless manner, in dimensions as shown on the drawings.
- D. Color: Provide a standard granite pattern with a high gloss finish as selected by the Architect.

PART 3: EXECUTION

3.1 INSTALLATION:

- A. Install in accordance with manufacturer's instructions and approved shop drawings. Install accessories plumb, square, level and true with wall or surfaces.

3.02 CLEANING:

- A. Remove all manufacturer's temporary labels or marks of identification. Clean and polish to remove all oil, grease, and foreign material. Leave in a neat, orderly and clean condition acceptable to the Architect.

END OF SECTION

SECTION 07140

FLUID APPLIED WATERPROOFING

PART 1: GENERAL

1.01 Description of Work

- A. This specification is for the application of Wall Guardian FW-100 to provide a continuous air barrier system where indicated.

1.02 References

- A. ASTM D 2939: Solids by Weight and Volume
- B. ASTM D 412: Tensile Strength & Elongation
- C. ASTM D 4586 modified: Elevated Temperature Sag Resistance
- D. ASTM E 96, Method B: Water Vapor Permeance (perms)
- E. ASTM E 283 modified: Air Rate Leakage Thru Cured film
- F. FL Building Code, TAS 114: Bond Strength to Concrete, Structural Performance/Adhesion Under Static Air Pressure ("Wind Resistance")

1.03 Quality Assurance

- A. Installer: Submit in writing a document stating that the applicator of the primary air barrier system specified is an acceptable applicator to the manufacturer
- B. Perform Work in strict adherence to the manufacturer's instruction
- C. Maintain one (1) copy of manufacturer's application instructions on job site
- D. Allow access to the Work by the air barrier manufacturer's representative
- E. Components used in this section shall be obtained from a single distributor
- F. With 7 days notice a pre-job conference is to convene prior to commencing the Work
- G. Mock up: as directed by the architect and it may remain as part of the Work.

1.04 Product Storage and Handling

- A. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and the product
- B. Store roll materials on end and in original packaging and always above 40°F. Keep away from all flame or excessive heat.

1.05 Job Condition

- A. Work is to be performed only in climatic conditions stipulated by manufacturer which are normally 40°F and rising with a maximum Relative Humidity of 80%. No application in the presence of dew, fog or when rain is forecast within 12 hours.
- B. All preparation work must be complete prior to installation of air barrier membrane

1.06 Protection And Coordination

- A. Ensure that the air barrier membrane is continuous where indicated in the drawings

PART 2: PRODUCTS

2.01 Characteristics – Wall Guardian FW-100 Air Barrier

- A. Vehicle Base: Asphalt
- B. Water Vapor Permeance: 11.6 perms
- C. Weight per Gallon: 8.6 lbs.
- D. Solids by Weight: 59 ± 2%
- E. Solids by Volume: 58 ± 2%
- F. Elongation @ break: >90%
- G. Tensile Strength: 29 psi
- H. Dry Time:
- I. Sets to Touch in 4-6 hours

- J. Recoat in 24 hours
- K. Exposure: 6 months
- L. Solvent: Mineral Spirits
- M. Clean Up: Mineral Spirits

Air Barrier Properties at 26.7 ft²/gallon

- N. Sag/Flow – ASTM D4586: none @ 180°F
- O. Air Rate Leakage – ASTM E283: none
- P. Bond Strength to Concrete, FBC (FL Bldg Code), TAS 114, Appendix H, Sec 2: > 1000 lb
- Q. Structural Performance, TAS 114 performed, Moisture Vapor Permeance after 250 hrs QUV (ASTM E96, Method B): 20.5 perms

2.02 Characteristics – GreatSeal LT-100 Liquid Tape

- A. Viscosity: non-slump, gun grade mastic, 750,000 cps @ 72°F
- B. Skin Over Time: 25 minutes. @ 72°F 40% RH
- C. Set time (60mil film): 1 hour @ 72°F 40% RH
- D. Appearance: lightly textured, distinctive blue color
- E. Density: specific gravity = 1.1 or (8.0# / gallon)
- F. Durometer: 27 Shore A
- G. Odor: mild mint ester
- H. VOCs: 0%, zero
- I. Solids: 100%
- J. Exposure: 6 months

Test Results:

- K. Hardness, ASTM D-2240: 27 Shore A
- L. Tensile, ASTM D412/C1135: 160 psi
- M. Tensile @ 50% Elongation, ASTM C1184: 75 psi
- N. Tensile @ 100% Elongation, ASTM C1184: 115 psi
- O. Elongation, ASTM D412/C1135: 200%
- P. Tear Strength, ASTM D624: 3.4# (Type T)
- Q. Shear Strength, ASTM C961: 140 psi
- R. Peel Strength 1, ASTM C794: 3.75 pli
- S. Peel Strength 2, ASTM C794: 4.5 pli
- T. Joint Movement Capability, ASTM C719: 12.5%

PART 3: EXECUTION

3.01 Examination

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Follow all manufacturer instructions on acceptability of substrate.

3.02 Preparation

- A. All substrates must be sound, hand dry, clean and free of oil, grease, excess mortar, dust or other contaminants. Starting the work is an acceptance of the substrate.

3.03 Installation

- A. Sheathing Joint Treatment (complies with IECC moisture management requirements)
 - 1) Joints between panels of exterior grade gypsum, plywood and rigid insulation greater than 3/8" wide shall be filled with a trowel application of FW-100 and reinforced with a strip of 2" wide glass fiber tape prior to application of liquid membrane. Joints 3/8" wide or smaller shall be treated with GreatSeal LT-100
 - a. GreatSeal LT-100 Liquid Tape is a one component ready to use material that requires no mixing or preparation.
 - b. Use the manufacturer's approved applicator tip to ensure proper application.

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FLUID APPLIED WATERPROOFING

- c. Application shall occur only when temperatures are above 40°F and inclement weather is not predicted.
 - d. Cut the plastic nozzle at a 45 degree angle. when manufacturer's applicator tip is not available
 - e. Begin gunning the material filling the joint from the bottom to the surface ensuring there are no voids or air pockets in the joint.
 - f. Applied in a 1/4" bead.
 - g. Tool to 3/4" by 1/16" cap seal that becomes tack free in twenty minutes.
 - h. It cures to a firm rubber seal in one hour.
 - i. For best finishing performance do not allow un-tooled beads to stand for more than ten minutes.
- 2) Transitional joint surfaces should be flashed in with beams, columns, window and doorframes, etc. using UT-40 Universal Tape lapped a minimum of 2" on both substrates.
 - 3) Mechanical attachment should be made to all window and doorframes, or a properly designed sealant joint provided.

B. Air Barrier

- 1) Frame Walls with OSB, plywood, gypsum sheathing including Dens Glass Gold
 - a. FW-100 may be applied with heavy brush, rollers, heavy-duty spray equipment or spreaders on a completely dry surface.
 - b. FW-100 may be applied in a single coat.
 - c. Mark areas off and ensure that the appropriate volume has been applied over each area.
 - d. During spraying, the product should be applied in horizontal strokes, then vertical strokes in a cross-hatch method to ensure even application.
 - e. Apply Wall Guardian FW-100 at 3.75 gallons per 100ft² minimum.
- 2) CMU Walls
 - a. Must use an ASTM C 578 Type IV or X outboard insulation at least 1" thick.
 - b. Apply Wall Guardian FW-100 at 3.75 gallons per 100 ft² minimum.

3.04 Protection of Finished Walls A. These materials are not meant for permanent exposure: 6 months maximum

END OF SECTION

SECTION 07150
DAMPPROOFING

PART 1: GENERAL

1.01 DESCRIPTION:

- A. Work included: Dampproofing required for this work is limited to dampproofing of masonry units so designated on the drawings.
- B. Related work described elsewhere:
 - 1. Painting - Section 09900

1.02 QUALITY ASSURANCE:

- A. Qualification of applicators: Use adequate number of skilled personnel who are thoroughly trained and experienced in the necessary skills, completely familiar with the manufacturer's recommended methods of application, and completely familiar with the specified requirements for this work.
- B. Manufacturer's certification: Prior to start of installation of the work of this Section, and during progress of that work, secure a visit to the job site by an authorized representative of the manufacturer of the dampproofing material, who shall inspect and shall certify:
 - 1. That the surfaces to which dampproofing was applied were in a condition suitable for that application;
 - 2. That the materials applied conform to the specified requirements;
 - 3. That the materials were applied in complete accordance with the manufacturer's current recommendations.

1.03 SUBMITTALS:

- A. General: Comply with the provisions of Section 01300.
- B. Certification: Upon completion of the work of this Section, and as a condition of its acceptance, deliver to the Architect the certification required under Paragraph 1.02B above.
- C. Guarantee: Accompanying the certification, deliver to the Architect the Manufacturer's standard guarantee, signed by the applying firm and endorsed by the manufacturer, stating that the dampproofing will remain intact and resist water for a period of five years following date of application.

1.04 PRODUCT HANDLING:

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 DAMPPROOFING MATERIAL:

- A. The outside face of the inside wythe of masonry, CMU, or brick, of all exterior walls shall receive one coat of "Hydrocide" mastic (heavy-fibrated coating) #700 as manufactured by L. Sonneborn, Inc., "Dehydratine No. 10" as manufactured by A.C. Horn Company, Koppers, or approved equal.

PART 3: EXECUTION

3.01 INSPECTION:

- A. Examine the areas and conditions under which work of this Section will be applied. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Preparation: Properly and thoroughly prepare all surfaces to receive dampproofing, complying with the manufacturer's recommendations.
- B. Application: Apply the specified material in strict accordance with the manufacturer's recommendations, covering all areas where dampproofing is required to prevent penetration of moisture through the concrete unit or brick masonry.
 - 1. Apply 4½ gallons per 100 square feet, in thickness, in consistency, as furnished.
 - 2. Mastic shall be smooth, unbroken coating, free in pinholes and other surface breaks, forming a cove at junction of masonry at concrete on which it bears or against which it terminates. Also, around all joints grooves and slots.

END OF SECTION

SECTION 07200

BUILDING INSULATION

PART 1: GENERAL:

1.01 PROJECT DESCRIPTION:

- A. Work Included: Provide all building insulation required for this work including, but not necessarily limited to:
 - 1. Sound Walls
 - 2. Exterior Walls
 - 3. Ceilings

1.02 PRODUCT HANDLING:

- A. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect the installed work and materials of all other trades.
- B. Delivery and Storage: Deliver materials to the jobsite, and store in a safe dry place with all labels intact and legible at time of installation.
- C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 INSULATION MATERIALS:

- A. General: All insulation material shall be the product of Owens/Corning Fiberglass, or an equal approved in advance by the Architect.
- B.. SOUND WALLS INSULATION: All metal or wood stud and gypsum board partition walls, such as corridor walls, all walls enclosing toilet rooms, work areas, offices, closets, etc., shall receive 3 ½" or 6" thick "Noise Barrier" unfaced batts, 16" in net width x full height of partition.
- C. CEILINGS: Where shown on drawings.
- D. FIRE SAFING INSULATION: By IIG Min Wool 1200 safing with FSP one face or equal to be installed at fire rated walls where fire rating runs to the bottom of roof or floor assemblies. Where indicated on drawings.

2.02 OTHER MATERIALS:

- A. All other materials, not specifically described but required for a complete and proper installation of the work of this section, shall be as selected by the Contractor subject to the approval of the Architect.

PART 3: EXECUTION

3.01 INSPECTION:

- A. Examine the areas and conditions under which work of this section will be installed. Correct conditions detrimental to proper and timely completion of the work. Do not proceed until satisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Except as otherwise specifically directed by the Architect, install all building insulation in accordance with the current edition of "Fiberglass Building Insulation Application Instructions", publication 3-BL-4992 of the Owens/Corning Fiberglas Corporation.

3.03 VERIFICATION:

- A. Upon completion of the installation in each area, visually inspect and verify that all insulation is complete and properly installed.

END OF SECTION

SECTION 07217

CAVITY WALL INSULATION

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification Sections, apply to this Section.

1.02 SUBMITTALS:

- A. Manufacturer's product literature, including specified physical properties.
- B. Installation instructions.
- C. Certification that product complies with specification requirements and is suitable for the use indicated.
- D. Manufacturer's Thermal Performance Warranty.

1.03 QUALITY ASSURANCE:

- A. CAVITYMATE Insulation shall not be produced with, or contain, any of the United States EPA regulated CFC compounds listed in the Montreal Protocol of the United Nations Environmental Program.

1.04 PRODUCT HANDLING:

- A. Protect insulation from physical damage.
- B. Comply with manufacturer's recommendations for handling, storage and protection.
- C. Handle boards carefully so corners are not broken off or boards otherwise damaged.

1.05 WARRANTY:

- A. Provide written warranty that the actual thermal resistance of the extruded polystyrene foam insulation will not vary by more than 10% from its published thermal resistance.
- B. Warranty period is 15 years after date insulation is purchased.

PART 2 – PRODUCTS:

2.01 INSULATION:

- A. Material Properties:
 - 1. Rigid closed cell extruded polystyrene thermal board insulation.
 - 2. Comply with ASTM C 578-95, Type X, density 1.35 lb/cu. ft. min., compressive strength 15 psi (ASTM D 1621-94).
 - 3. Thermal resistance: 5 year aged R-values of 5.4 and 5.0 min. °F-ft²-h/Btu²/inch at 40°F and 75°F respectively (ASTM C 518-91).
 - 4. Water absorption: Max. 0.1% by volume (ASTM C 272-91(96)).
 - 5. Surface Burning Characteristics:

SECTION 07217
CAVITY WALL INSULATION

- a. Flame Spread: 5.
 - b. Smoke Developed: 165.
- B. Thickness: 2" (R-10). 16"x 96" with butt edge.
- C. Acceptable manufacturer's product:
 - 1. The Dow Chemical Company
 - 2. Owens Corning Foarmular CW15 rigid extruded polystyrene thermal board insulation.
 - 3. "STYROFOAM® Brand Cavitymate®

2.02 ADHESIVE:

- A. Adhesive: type recommended by insulation manufacturer.
- B. Acceptable manufacturer's products:
 - 1. ChemRex, Inc. "Contech Brands PL300 Foam Board Adhesive".
 - 2. ChemRex, Inc. "Contech Brands Premium FoamBoard Adhesive".
 - 3. Dacar Products, Inc. "Foamgrab PS".
 - 4. STS Coatings, Inc. "Great Seal LT-100 Liquidtape"

PART 3 - EXECUTION:

3.01 INSPECTION AND PREPARATION:

- A. Verify that masonry joints are struck flush and that other conditions are satisfactory for proper installation.
- B. Remove concrete fins and mortar projections that interfere with placement of insulation boards.

3.02 INSTALLATION:

- A. Apply 2" diameter daubs of adhesive spaced approximately 12" o.c. both ways on inside face of insulation board.
- B. Butter all edges of insulation board with adhesive to provide continuous vapor barrier.
- C. Fit insulation between wall ties and other obstructions with joints staggered and edges butted tightly.
 - 1. Press units firmly against inside wythe of masonry or other construction.
 - 2. Wedge insulation from outside wythe of construction with small fragments of masonry materials spaced 24" o.c. both ways.
 - 3. Make insulation continuous. Fill all voids.

3.03 CLEAN-UP:

- A. Remove and dispose of excess insulation, wrappings and other waste materials.

END OF SECTION

SECTION 07234

TAPERED ROOF INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 – Specifications sections, apply to work of this section.
- B. SECTION 03540 – LIGHTWEIGHT INSULATION CONCRETE DECK
- C. SECTION 06100 – WOOD DECK REPAIRS
- D. SECTION 06110 – WOOD FRAMING
- E. SECTION 07225 – ROOF INSULATION FOR WOOD DECKS
- F. SECTION 07230 – ROOF INSULATION FOR NAILABLE CEMENTITIOUS DECKS

1.02 SUMMARY:

- A. It is the intent of this specification to provide the owner with an insulation system that will provide positive drainage of all standing water, and the assurance of long term thermal performance throughout the life of the installed roof membrane.
- B. The entire insulation system shall be installed in accordance with the latest published data of the American Society of Testing Materials (ASTM) Standard, Underwriters Laboratory (UL) and Factory Mutual (FM) fire rating classification.
- C. Manufacturers' literature shall be submitted to the project manager denoting the system used, the 'R' value stated, minimum and maximum thickness of the insulation, complete code compliance, and written confirmation of total adherence to these specifications.
- D. Roof Areas covered under this section: as shown on drawing.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Insulation shall be delivered to the site in an undamaged and dry condition. Material received which is not dry or is otherwise damaged shall be rejected.
- B. Storage under polyethylene or similar non-breathing film stock shall not be permitted.
- C. Proper storage on or off the site shall be the responsibility of the roofing contractor.
- D. Any unused insulation remaining on the roof at the end of the workday shall be returned to storage.

1.04 TAPERED INSULATION – GENERAL:

- A. Insulation boards shall be full size except when cutting is required at roof edges and openings. Boards that are broken, cracked, have been exposed to moisture, or are otherwise damaged shall not be used.
- B. The proper installation and fit of wood nailers, blocking, and other rough carpentry in appropriate locations shall be verified prior to installation of roof insulation.

- C. Caution shall be exercised with construction traffic to avoid damage to new insulation. Breaking or crushing of insulation is unacceptable and any damaged insulation shall be replaced at the roofing contractor's expense.
- D. Insulation shall be laid with end joints staggered and all joints tight; however, boards shall not be forced into place.
- E. No more insulation shall be applied during any work period than can be covered by all plies of roofing during the same work period. At the end of the work period, temporary edge seals shall be installed to protect the roof insulation. Upon resumption of work, they must be removed. Such seals shall consist of strips of roofing felt applied and top coated with asphalt mastic.
- F. Insulation surfaces shall be cleared of all debris before roofing is placed.

1.05 SHOP DRAWINGS:

- A. Shop drawings should be presented in a clear and thorough manner.
- B. All tapered insulation panels should be installed in accordance with shop drawings approved by the project manager.
- C. All locations, roof penetration, and other pertinent information regarding the roof assembly shall be noted.
- D. All shop drawings should reflect on-site field measurements of roof.

PART 2 – PRODUCTS

2.01 GENERAL:

- A. This section is complimentary to the membrane roofing system specified. All insulation materials supplied must be compatible with/and to the approval of the roofing system manufacturer.

2.02 MATERIAL:

- A. Tapered insulation system shall be a rigid board type specifically formulated, and manufactured for the use as a thermal insulation over roof decking with smooth, continuous slope of 1/4 per foot.
- B. Insulation shall be:
 - 1. Install an average R value of R-20 Insulation system. Bottom base layer of 1" (R-60) Polyisocyanurate FS hh-1-1972/2(1), Class 1, to be mechanically fasten to steel decking. Maximum board size 4' x 8'. The Tapered insulation system shall be minimum 1/4 slope per foot tapered Polyisocyanurate of (R-6) per 1" thickness with adhesive for tapered layers ASTM D 312-95a, Type IV Asphalt. Maximum boards 4' x 4' and minimum of 1/2" thickness to achieve R value specified. Top layer cover board shall be minimum 1/2" Perlite ASTM C 728-91; insulation adhesive for top tapered layers shall ASTM D312-95a, Type IV Asphalt. Maximum board size of 4' x 4'.
- C. It is the intent of this specification of this specification to supply compatible insulation components that will provide assure system performance. Therefore, it is suggested that all material supplied by from a single insulation source whenever possible.

PART 3 – INSTALLATION

3.01 TAPERED INSULATION SYSTEMS:

- A. Tapered insulation system shall be installed in a minimum of two layers, with all joints staggered.
- B. The base layer shall of insulation shall be installed in a total thickness of $\frac{3}{4}$ inch.
- C. The top layer of insulation (tapered) will be factory fabricated to provide a smooth continuous slope of $\frac{1}{4}$ inch per foot.
- D. Layout shall be coordinated to allow for positive drainage around roof mounted supports or equipment.

3.01 TAPERED INSULATION SADDLES:

- A. Roof saddles are to be placed in valleys between roof drains.
- B. All saddle shall have a four (4) way slope twice that of roof deck.
- C. In no case should width of saddles be less than $\frac{1}{4}$ of total span between drains.
- D. Saddles shall be used for drainage purposes only, and shall not contribute to minimum “R” value system calculation specified herein.

END OF SECTION

SECTION 07411
NEW STANDING SEAM METAL ROOF SYSTEM

PART 1 - GENERAL

1.01 AREAS INCLUDED

- A. Metal Roof Area.

1.02 INSTALLER QUALIFICATIONS

- A. Roofing installer must be:

1. Must be acceptable to roof material manufacturer for the manufacturer's warranty requirements.
2. Currently in good standing with the manufacturer.
3. Installer must be an experienced single firm specializing in the type of roof installation, roofing repair and/or removal and replacement work required, employing only experienced workers for the class of work in which they are employed, having at least five (5) years successful experience on projects similar in size and scope and acceptable as applicators by the Owner's representative.
4. Contractor must have successfully completed previous projects warranted by the manufacturer.

- B. It shall remain each Bidder's responsibility to determine his current status with the manufacturer's certification plan.

1.03 REFERENCES (INCLUDING LATEST REVISIONS)

- A. American Architectural Manufacturer's Association (AAMA): www.aamanet.org:

1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.
2. AAMA 809.2 - Voluntary Specification Non-Drying Sealants.

- B. American Society of Civil Engineers (ASCE): www.asce.org/codes-standards:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

- C. ASTM International (ASTM): www.astm.org:

1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
4. ASTM A 980 - Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.
5. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
6. ASTM C 920 - Specification for Elastomeric Joint Sealants.
7. ASTM D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.
8. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

9. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
 10. ASTM E 1514 - Standard Specification for Structural Standing Seam Steel Roof Panel Systems.
 11. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
 12. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 13. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
 14. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- D. Cool Roof Rating Council (CRRC): www.coolroofs.org/productratingprogram.html:
1. CRRC-1-2008 - CRRC Product Rating Program.
- E. FM Global (FM): www.fmglobal.com:
1. ANSI/FM 4471 - Approval Standard for Class 1 Panel Roofs.
- F. International Accreditation Service (IAS):
1. IAS AC 472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B.
- G. Underwriters Laboratories, Inc. (UL): www.ul.com:
1. UL 580 - Tests for Uplift Resistance of Roof Assemblies
 2. Roofing Covering: Class A fire hazard classification.
- H. US Environmental Protection Agency: www.energystar.gov/index.cfm:
1. Energy Star Reflective Roof Products.
- I. US Green Building Council (USGBC): www.usgbc.org:
1. LEED - Leadership in Energy and Environmental Design (LEED) Green Building Rating Systems.
- J. Federal Specifications:
1. LLL-I-535B
 2. SS-A-701B
 3. SS-C-153
 4. SS-C-153C
 5. SS-R-620B
 6. TT-C-498C
 7. TT-P-320D
 8. TT-S-00227E
 9. TT-S-00230C
 10. SS-S-001534 (GSA-FSS)
 11. L-P-375
- K. Industry Standards:
1. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
 2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual

L. Testing Laboratory Services: Test results shall meet or exceed established standards.

1.04 SUBMITTALS

A. Samples and Manufacturer's Submittals: Submit prior to delivery or installation.

1. Samples of all roofing system components including all specified accessories.

2. Submit samples of proposed warranty complete with any addenda necessary to meet the warranty requirements as specified.

3. Submit latest edition of manufacturer's specifications and installation procedures. Submit only those items applicable to this project.

4. A written statement from the roofing materials manufacturer approving the installer, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.

B. Shop Drawings: Provide manufacturer's approved details of all perimeter conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.

C. Maintenance Procedures: Within ten days of the date of Substantial Completion of the project, deliver to the Owner three copies of the manufacturer's printed instructions regarding care and maintenance of the roof.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original packaging with all labels intact and legible, including labels indicating storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four inches (4") off the substrate, and the tarpaulin tied off with rope.

C. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.

D. Deliver materials in sufficient quantity to allow continuity of work.

E. Handle and store material and equipment in such a manner as to avoid damage. Liquid products shall be delivered sealed, in original containers.

F. Handle rolled goods so as to prevent damage to edge or ends.

G. Select and operate material handling equipment so as not to damage existing construction or applied roofing.

H. Moisture-sensitive products shall be maintained in dry storage areas and properly covered. Provide continuous protection of materials against wetting and moisture absorption. Store roofing and flashing materials on clean raised platforms with weather protective covering when stored outdoors.

- I. Store rolled goods on end.
- J. Protect materials against damage by construction traffic.
- K. The proper storage of materials is the sole responsibility of the contractor and any wet or damaged roofing materials shall be discarded, removed from the project site, and replaced prior to application.
- L. Comply with fire and safety regulations, especially with materials which are extremely flammable and/or toxic. Use safety precautions indicated on labels.
- M. Products liable, such as emulsions, to degrade as a result of being frozen shall be maintained above 40° F in heated storage.
- N. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form.

1.06 SITE CONDITIONS

- A. Job Condition Requirements:
 - 1. Apply roofing in dry weather.
 - 2. Do not apply roofing when ambient temperature is below 40° F (4° C).
 - 3. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with specifications.
 - 4. For further information regarding roofing material manufacturer's recommendations for project conditions, refer to the manufacturer's published application manual.
 - 5. All surfaces to receive new roofing shall be smooth, dry, and free from dirt, debris, and foreign material before any of this work is installed. Competent operators shall be in attendance at all times equipment is in use. Materials shall be stored neatly in areas designated by the Owner. Load placed on the roof at any point shall not exceed the safe load for which the roof is designed.
 - 6. The contractor shall take all necessary precautions to protect the roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Owner's on-site representative shall determine damage caused by contractor negligence.
 - 7. Follow insurance underwriter's requirements acceptable for use with specified products or systems.
 - 8. All kettles shall have an automatic thermostat control, and temperature gauge, all in working order.
 - 9. Surface and air temperatures should be a minimum 45° F during applications of cleaner and waterproof coating and remain above 45° F for a minimum of four (4) hours following applications. Verify compatibility of cleaner with coatings, paints, primers and joint sealers specified. Advise Owner's representative of any problems in this regard prior to commencing cleaning operations.
 - 10. Temporary Sanitary Facilities: The contractor shall furnish and maintain temporary sanitary facilities for employees' use during this project. These will be removed after the completion of the project. All portable facilities shall comply with local laws, codes, and regulations.
- B. Protection of Work and Property:

1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations pertaining to asbestos as required shall be fulfilled by the contractor as part of his proposal.
 2. Twenty-four Hour Call: The contractor shall have personnel on call 24 hours per day, seven (7) days per week for emergencies during the course of a job. The Owner's project manager is to have the 24 hour numbers for the contact. Contractor must be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers available to the Owner's project manager are to be both home and office numbers for:
 - a) Job Foreman
 - b) Job Superintendent
 - c) Owner or Company Officer
 - C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds must be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.
 - D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.
 - E. Cleaning and Disposal of Materials:
 1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
 2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. A suitable scrap chute or hoist must be used to lower any debris. At completion, all work areas shall be left broom clean and all contractor's equipment and materials removed from the site.
 3. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
 4. Debris shall be deposited at an approved disposal site.
- 1.07 WARRANTY
- A. **Special Weathertightness NDL Warranty:** On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail to remain weathertight, including leaks, without monetary limitation within 20 years from date of Substantial Completion.

- 1 B. Project shall be completed in such a manner that the material manufacturer shall furnish a
2 standard twenty (20) year warranty on the product finish against oxidation failure.
- 3 C. Roofing - Contractor: The contractor, jointly with any subcontractors employed by him,
4 shall guarantee the work required and performed under this contract will be free from
5 defects in workmanship and materials, and that the building will be and remain waterproof
6 for a two (2) year warranty period, after the Owner accepts the work as substantially
7 complete. The warranty shall be in approved notarized written form, to obligate the
8 contractor and his subcontractors, if any, to make good the requirements of the warranty.
9
- 10 D. Warranty repairs shall be performed by a certified installer. The repairs shall be performed in
11 accordance with the manufacturer's written instructions and recommended procedures so
12 as to not void the warranty. Repair of the system, including materials and labor, shall be
13 done at no cost to the Owner.
14
- 15 E. During the proposal period each Bidder shall make arrangements with the material
16 manufacturer to provide the required warranty. Refer to SUBMITTALS Paragraph above in
17 this section for requirements concerning submittals of warranty.
18
19

20 **PART 2 - PRODUCTS**

21
22 2.01 GENERAL

- 23
- 24 A. All materials shall be furnished, specified, or approved in writing by the manufacturer
25 issuing the warranty.
26
- 27 B. Samples of all materials used on the project, which are not supplied by the membrane
28 manufacturer, shall be submitted to the membrane manufacturer for written approval prior
29 to work starting.
30
- 31 C. All materials used on the project shall be asbestos free.
32

33 2.02 UNDERLAYMENT MEMBRANE

- 34
- 35 A. Membrane shall be nominal sixty (60) mil in overall thickness consisting of forty-five (45)
36 mil thick calendered coal-tar elastomeric membrane thickness with fifteen (15) mil thick
37 backing of styrene butadiene styrene (SBS) adhesive with a selvage edge. The self-
38 adhering membrane shall be a high-performance elastomeric membrane incorporating
39 DuPont™ Elvaloy® KEE (ketone ethylene ester), extended with coal-tar pitch and
40 reinforced with polyester fibers.
41
- 42 B. The self-adhering membrane shall meet the following physical properties: Elongation
43 170%, ASTM D 412; Tensile Strength 1600 lbs/in², ASTM D 412; Tear Strength 300 ppi,
44 ASTM D 624; Density @ 70° F, 80 lbs/ft³; Low Temperature Flexibility, Pass, 37-GP-56M;
45 and Water Absorption less than 0.1%, 37-GP-56M. Roll shall have one and one-half inch
46 (1-1/2") wide dry lap for hot-air welding.
47

2.03 UNDERLAYMENT FLASHING MEMBRANE

- A. Flashing shall be same base material as the finish ply self-adhered coal-tar elastomeric membrane (CTEM) and be installed using the design principles set forth in the National Roofing Contractors Association Manual and attached details.

2.04 END LAP MEMBRANES

- A. Shall be a sixty (60) mil overall calendered thickness membrane. The membrane shall be a high performance elastomeric membrane incorporating a DuPont™ Elvaloy® KEE (ketone ethylene ester), extended with coal-tar pitch and reinforced with polyester fibers.
- B. End lap splice strip shall be the same type material as the finish ply membrane not to exceed nominal 60 mils in overall calendered thickness. Strips shall be nine inches (9") by forty-two inches (42") long. All four edges shall have a minimum one and one-half inch (1-1/2") wide dry lap for hot-air welding.

2.05 CAULKS

- A. Sealant for use at coping joints, reglet joints, etc., shall be a one-component urethane non-sag, gun grade sealant designed for use in active exterior joints, and shall meet or exceed Federal Specification No. 1 TT-S-00230C, Type II, Class A, ASTM C 920. Where joint surfaces are contained or are contaminated with bituminous materials, provide manufacturer's modified-type sealant (modified with coal-tar or asphalt as required) as manufactured by Sonneborn (RC-708), or approved equal.
- B. To seal the leading edge of the CTEM membrane, to bond CTEM at terminations with metal, and for open CTEM seam repair, sealant shall be a thermosetting, solvent free, non-slump, self-fixturing, multipurpose structural sealant which shall meet the following physical and performance properties, M-1 as manufactured by Chem Link Inc., or approved equal.

Properties

Specific Gravity	1.62 (13.5 lbs./gallon)
Viscosity	800,000 cps Brookfield RTV, TF spindle, 4 rpm 70 degrees F.
Shear Strength (ASTM D-1002)	300 psi+ (7 day ambient cure)
Elongation @ break (ASTM D-412)	300% (7 day ambient cure)
Hardness Shore A (ASTM C-661)	50 – 55 (14 day ambient cure)
Tack free time (ASTM C-679)	35 minutes
Low temperature flex	Minus 20 degrees F: PASS
Slump (sag) (ASTM C-639)	Zero slump
Shrinkage (ASTM D-2453)	No measurable shrinkage (14 day cure)
Service temperature	-40 degrees F to 200 degrees F

2.06 FASTENERS

- A. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.

B. Fastener for Metal Roof Insulation and Plywood Sheathing Application: Shall be a #14 fastener, fluorocarbon coated, with CR-10 coating. A minimum .200 diameter shank and .250 diameter thread. To be used with round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to thirty (30) Kesternich cycles (DIN 50018) shows less than 10% red rust which surpasses Factory Mutual Approval Standard 4470. Fasteners, plates, and/or bars shall be listed in the Factory Mutual Approval Guide.

C. Fastener for panel clips through plywood sheathing and rigid insulation and into metal deck shall be #14 type Phillips head. Two (2) screws per clip. Screws to be minimum ½" longer than the total thickness of the plywood sheathing, rigid insulation and metal deck when screwed thru the bottom flute of the metal deck.

D. Fasteners for Miscellaneous trims and accessories shall be as recommended by the roof panel manufacturer.

2.07 WOOD

A. All nailers, wooden cants and wooden curbs shall be treated lumber as required by NRCA, Factory Mutual and Underwriters Laboratory and installed according to NRCA and Factory Mutual guidelines.

2.08 STYRENE BUTADIENE STYRENE (SBS) PRIMER

A. SBS primer made from natural resins, solvent and synthetic rubber. For application on concrete, metal or wooden substrate.

2.09 STANDING SEAM ROOF PANELS

A. Mechanically Seamed, Concealed Fastener, Trapezoidal Seam Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with raised trapezoidal ribs at panel edges, installed by lapping and mechanically interconnecting edges of adjacent panels, and attaching panels to supports using concealed clips and fasteners in a weathertight installation.

1. Basis of Design: MBCI, Double-Lok

2. **Aluminum-Zinc Alloy-Coated Steel Sheet:** ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ50 (Grade 340, Coating Class AZM150), prepainted by the coil-coating process per ASTM A 755/A 755M.

a. Nominal Thickness: No.24 MSG min.

b. Panel Surface: Smooth with minor ribs in pan.

c. Exterior Finish: Fluoropolymer two-coat system.

d. Color: As selected by Architect from manufacturer's standard colors.

3. Panel Width 18 inches.

4. Panel Seam Height: 3 inch.

5. Joint Type: Double folded.

2.10 METAL ROOF PANEL ACCESSORIES

A. General: Provide complete metal roof panel assembly incorporating trim, fasciae, gutters and downspouts, and miscellaneous flashings, in profiles as indicated. Provide required fasteners, closure strips, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.

B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.

- C. Two Piece Floating Clips: ASTM C 645, with ASTM A 653/A 653M, G90 (Z180) hot-dip galvanized zinc coating, with a No. 14 MSG coated steel base and No. 22 MSG coated steel top, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- D. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, and heads matching color of metal panels by means of factory-applied coating.
- E. Wind Clips: Provide manufacturer's wind clamps. Clamps shall be installed at 12" o.c. as required by the manufacturer.
- F. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
 2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
- G. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 hot-dip galvanized zinc coating as applicable.
- H. Roof Accessories: Approved by metal roof panel manufacturer. Refer to Section 07 72 00 "Roof Accessories" for requirements for roof accessories.

2.11 FINISHES

- A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621, meeting solar reflectance index requirements.
1. Basis of Design: MBCI, Signature 300.
- C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

2.12 POLYISOCYANURATE RIGID BOARD ROOF INSULATION

- A. Polyisocyanurate Roof Insulation: Insulation shall be two layers of rigid polyisocyanurate foam board; total thickness and LTTR-value shall be minimum of 4.5" = 25; meeting Federal Specification No. HH-I-1972/1 or 2 with 20 psi minimum compressive strength and 2.0 pcf minimum density. Board shall be surfaced on two (2) sides with non-asphaltic facer material.

2.13 SUBSTRATE BOARD (PLYWOOD SHEATHING)

- A. Plywood decking (substructure) to be one-half (1/2") inch thick, exposure sheathing span C-D 40/20 plywood.

2.14 FLEXIBLE PIPE FLASHING SYSTEM

- A. Flexible, one piece, pipe flashing system, made of long life, weatherproof gray EPDM rubber or red silicone; shall have corrosion resistant aluminum base which will conform to any panel configuration, as manufactured by metal panel manufacturer or approved equal.

2.15 DELIVERY AND STORAGE

- A. All materials shall be delivered with appropriate carton and can labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

2.16 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

2.17 MISCELLANEOUS MATERIALS

- A. Other materials shall be as specified or of the best grade for the proposed use as recommended by the manufacturer.

PART 3 - EXECUTION

3.01 REFERENCE

- A. The manufacturer's Technical Specifications shall be considered a part of this specification and should be referred to for more specific application procedures and recommendations.
- B. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.
- C. General Installation:
1. Protect adjacent areas with tarpaulin or other durable materials.
 2. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 3. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
 4. All surfaces/substrates shall be clean and dry prior to application of materials.
 5. Prior to application of membrane, all foreign matter, debris, gravel, etc., shall be removed from the insulation and/or substrate. Gravel or debris between the insulation/substrate and plies is not acceptable.
 6. Ambient temperature shall be 50° F and rising.

7. Any self-adhered membranes shall be picture framed on all roof areas as the system is being applied. All end laps of the field sheets of the self-adhered coal-tar elastomeric membrane shall lap the picture frame sheet a minimum of eight inches (8") or the picture frame sheet side laps shall lap the field sheet a minimum of eight inches (8").
8. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
9. Dry voids of felt on felt or membrane on membrane are not acceptable.
10. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
11. All surfaces that are to receive the self-adhered membranes shall be primed with a fast drying asphaltic primer. Except when self-adhered membrane is to be installed over a CTEM surface.

3.02 SUBSTRATE PREPARATION

- A. Substrate shall be smooth, free of debris, sharp edges, and other surface irregularities prior to starting roofing application. Substrate repair shall be performed as required to minimum of NRCA standards.
- B. Wood Substrate:
 1. Cracks wider than one-fourth inch (1/4"), or any opening of more than one-half inch (1/2"), shall be covered with securely nailed sheet metal.
 2. Care should be exercised so that the substrate is not damaged.
 3. Any substrate decking which is damaged, wet, or rotted must be replaced with new to match. All boards shall be securely fastened to the supporting structure beneath.
 4. Plywood decks shall be of exterior grade and securely nailed to supporting members. The plywood shall be a minimum of one-half inch (1/2") in thickness.
 5. All wood substrates shall be covered with self-adhered CTEM applied to wood substrate, nailed along perimeter only.

3.03 NAILERS

- A. Wooden nailers shall be installed at gravel stops or drip edges on outside perimeter of building according to NRCA, Factory Mutual and Underwriters Laboratory guidelines.
- B. All Construction: Nailers shall be the same height as the new insulation being installed where required. All shall be installed according to Factory Mutual and Underwriters Laboratory Guidelines.

3.04 THERMAL INSULATION AND SUBSTRATE BOARD

- A. Specified insulation and substrate board shall be mechanically fastened to conform to the ASCE 7 criteria for wind uplift as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of IBC and the manufacturer that are in effect at the time of this project. Boards shall be staggered and butted as close as possible with voids over one-fourth inch (1/4") to be filled.

B. Insulation shall be loose laid with edges parallel to flutes and bearing on deck surface/flats. The long dimension of base insulation layer must be fully supported by the top flange of the metal deck. The edges of insulation boards must not cantilever over the flutes of the metal deck. When applying thermal insulation in two or more layers, offset all joints a minimum of six (6") inches each way. Maintenance fasteners may be used to hold insulation in place until substrate board is installed.

C. Over the thermal insulation mechanically fasten the specified substrate board thru all layers of the thermal insulation and into the metal deck as per AASCE 7 criteria for wind uplift as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of IBC and the manufacturer that are in effect at the time of this project.

3.05 APPLICATION OF UNDERLAYMENT

A. Unroll self-adhered membrane and allow to relax a minimum of two hours at 70° F plus temperature or longer if temperature is below 70° F. If after the period of relaxation, the membrane is not to be immediately installed, cover the membrane with white polyethylene tarp or release paper until ready for installation. All membrane applications shall be applied parallel with slope, no exceptions.

B. Slide the membrane in place aligning with three inch (3") lap line. Fold second half of relaxes roll over the first half of relaxed roll. Kiss cut the release paper at the fold, taking care not to cut the adhesive and/or membrane, install two feet (2') of self-adhered membrane pulling release paper low to roof line. Roll excess release paper on unused core and pull low to the roof surface removing the release paper while simultaneously setting the remainder of the self-adhered membrane in place. Upon completion, fold first half of membrane over installed second half and repeat procedure. The end laps of the finish ply membrane shall be a minimum of three inches (3").

C. Immediately following the laying of the self-adhering membrane, it shall be rolled in the width direction using a minimum seventy pound (70#) linoleum roller. This will prevent excessive entrapment of air beneath the membrane. The rolling is in the width direction and with the laps so as not to buck the laps.

D. Position the next roll of self-adhering membrane adjacent to the membrane already applied so that there is a three inch (3") side lap. The membrane has a one and one-half inch (1-1/2") dry lap; therefore, the three inch (3") side lap will comprise one and one-half inch (1-1/2") adhered lap and one and one-half inch (1-1/2") welded lap.

E. End laps of membrane shall be a minimum three inches (3"). If possible, lay the end laps in line.

F. Picture frame all roof areas with self-adhered coal-tar elastomeric membrane (CTEM) as finish membrane ply is being applied. Rectangular type projections should also be picture framed.

3.06 PERIMETER FASTENING

- A. Wood nailers are required for perimeter gravel stops or drip edges. Field membrane and all plies shall be mechanically fastened to nailer on twelve inch (12") centers maximum.

3.07 PROJECTION FLASHINGS

- A. Plumbing Vents: Soil vent stack pipes shall receive new boot flashings installed in strict accordance with practices set forth in the NRCA Roofing Manual. Projections that cannot be sealed thus should be boxed in and flashed as recommended by the roof membrane manufacturer.
- B. Square Projections: Lay the self-adhered coal-tar elastomeric membrane (CTEM) up to the projection, and cut membrane so that it will extend twelve inches (12") beyond the projection. Cut a slit in the membrane to correspond with the position of the projection, and lay the self-adhering membrane in place. Apply another layer of membrane in exactly the same fashion, but from the opposite direction. For metal flange-type projections, after doing above, strip in with six inch (6") strips of membrane.
- C. Round Projections: Cut membrane square and eighteen inches (18") from perimeter of projection. Slit square membrane with an "X" of proper size to ensure a close fit and positive seal. Place over projection, and adhere to clean membrane already on the roof. Cut a six inch (6") piece of membrane to apply as a collar, and secure with all stainless steel clamp.

3.08 METAL PANEL INSTALLATION

- A. Mechanically-Seamed, Trapezoidal Standing Seam Metal Roof Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.
- B. Attach panels to supports using clips, screws, fasteners, and sealants recommended by manufacturer and indicated on approved shop drawings.
1. Fasten metal panels to supports with concealed clips at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.
 2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 3. Provide manufacturer's wind clamps secured to panel ribs at 12" on center.
 4. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.
 5. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

3.09 ACCESSORY INSTALLATION

- A. General: Install metal panel trim, flashing, and accessories using recommended fasteners and joint sealers, with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.

2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
3. Provide concealed fasteners except where noted on approved shop drawings.
4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.

1. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Sealants."

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage an independent testing and inspecting agency acceptable to Architect to perform field tests and inspections and to prepare test reports.

3.11 CLEANING AND PROTECTION

A. Remove temporary protective films immediately in accordance with metal roof panel manufacturer's instructions. Clean finished surfaces as recommended by metal roof panel manufacturer.

B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION 07 41 13

SECTION 07541
FULLY ADHERED MULTI-PLY ROOF SYSTEM

PART 1 - GENERAL

1.01 AREAS COVERED

- A. Low Slope Roof Areas as indicated on plans

1.02 INSTALLER QUALIFICATIONS

- A. Roofing Installer must be:
1. Currently prequalified with the Owner in accordance with Owner's prequalification requirements.
 2. Currently in good standing with the manufacturer.
- B. It shall remain each Contractor's responsibility to determine his current status with the manufacturer's certification plan.

1.03 QUALITY ASSURANCE

- A. Applicator/Installer:
1. Acceptable to roof material manufacturer for the manufacturer's warranty requirements.
 2. Five (5) years successful experience on projects similar in size and scope.
 3. Experienced in the type of roofing work required.
 4. Successfully completed previous projects warranted by the manufacturer.

1.04 MANUFACTURER QUALIFICATIONS

- A. A qualified manufacturer that has been UL Listed and has FM Approvals for the membrane roofing system specified for use in this project for a minimum of fifteen (15) years.
- B. The roofing membrane manufacturer is defined as a company which makes the primary roofing membrane and flashing membrane in its own factories from ruder, rawer states of material. No "Private Label" roofing membrane or flashing membrane material (in which one company's name goes on a product manufactured by others) is acceptable for this project.
- C. Testing Laboratory Services: Test results shall meet or exceed established standards.
- D. Underwriters Laboratory (Roofing Covering): Class A fire hazard classification.
- E. Comply with governing local, state, and federal regulations, safety standards, and codes.

1.05 REFERENCES (INCLUDING LATEST REVISIONS)

- A. American Society for Testing and Materials:
1. ASTM B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate
 2. ASTM C 719 Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cycle Movement (Hockman Cycle)

3. ASTM C 794 Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
4. ASTM C 920 Specification for Elastomeric Joint Sealants
5. ASTM D 312 Specification for Asphalt Used in Roofing
6. ASTM D 1863 Specification for Mineral Aggregate Used on Built-up Roofs
7. ASTM D 2178 Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
8. ASTM D 2824 Specification for Aluminum - Pigmented Asphalt Roof Coatings
9. ASTM D 4586 Specification for Asphalt Roof Cement, Asbestos Free
10. ASTM A 361 Sheet Steel, Zinc-Coated (Galv.) by the Hot-Dip Process for Roofing and Siding
11. ASTM C 177 Test for Thermal Laboratory Services
12. ASTM C 728 Perlite Thermal Insulation Board

B. Federal Specifications:

1. LLL-I-535B
2. SS-A-701B
3. SS-C-153
4. SS-C-153C
5. SS-R-620B
6. TT-C-498C
7. TT-P-320D
8. TT-S-00227E
9. TT-S-00230C
10. SS-S-001534 (GSA-FSS)
11. L-P-375

C. Industry Standards:

1. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
2. Single-ply Roofing Institute (SPRI) - A Professional Guide to Specifications Manual
3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual
4. American Society of Civil Engineers – ASCE 7

1.06 SUBMITTALS

A. Samples and Manufacturer's Submittals: Submit prior to delivery or installation.

1. Samples of all roofing system components including all specified accessories.
2. Submit samples of proposed warranty complete with any addenda necessary to meet the warranty requirements as specified.
3. Submit latest edition of manufacturer's specifications and installation procedures. Submit only those items applicable to this project.
4. A written statement from the roofing materials manufacturer approving the installer, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.
5. Manufacturer's Equiviscous Temperatures (EVT) for the specified bitumens.

B. Shop Drawings: Provide manufacturer's approved details of all perimeter conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.

- C. Maintenance Procedures: Within ten days of the date of Substantial Completion of the project, deliver to the Owner three copies of the manufacturer's printed instructions regarding care and maintenance of the roof.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers and rolls with all labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.
- B. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.
- C. Deliver materials in sufficient quantity to allow continuity of work.
- D. Handle and store material and equipment in such a manner as to avoid damage. Liquid products shall be delivered sealed, in original containers.
- E. Handle rolled goods so as to prevent damage to edge or ends.
- F. Select and operate material handling equipment so as not to damage existing construction or applied roofing.
- G. Moisture-sensitive products shall be maintained in dry storage areas and properly covered. Provide continuous protection of materials against wetting and moisture absorption. Store roofing and flashing materials on clean raised platforms with weather protective covering when stored outdoors.
- H. Store rolled goods on end.
- I. Protect materials against damage by construction traffic.
- J. The proper storage of materials is the sole responsibility of the contractor and any wet or damaged roofing materials shall be discarded, removed from the project site, and replaced prior to application.
- K. Comply with fire and safety regulations, especially with materials which are extremely flammable and/or toxic. Use safety precautions indicated on labels.
- L. Products liable, such as emulsions, to degrade as a result of being frozen shall be maintained above 40° F in heated storage.
- M. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day.

1.08 SITE CONDITIONS

- A. Job Condition Requirements:
1. Apply roofing in dry weather.
 2. Do not apply roofing when ambient temperature is below 40° F.

3. Coordinate the work of the contractor with the work to be performed by the Owner's personnel, to ensure proper sequencing of the entire work. The Owner's personnel will be erecting interior protection for equipment, if required. The contractor is to schedule his work so that adequate time is allowed for the Owner's personnel to perform the work. No roof work shall be performed until the Owner's personnel have completed erection of the interior protection in that area.
4. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with specifications.
5. Schedule the work so the building will be left watertight at the end of each day. Do not remove more roofing material than can be reinstalled in any working day.
6. All surfaces to receive new roofing shall be smooth, dry, and free from dirt, debris, and foreign material before any of this work is installed. Competent operators shall be in attendance at all times equipment is in use. Materials shall be stored neatly in areas designated by the Owner. Load placed on the roof at any point shall not exceed the safe load for which the roof is designed.
7. The contractor shall take all necessary precautions to protect the roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Owner's on-site representative shall determine damage caused by contractor negligence.
8. The contractor shall follow local, state, and federal regulations, safety standards, and codes for the removal, handling, and disposal of asbestos containing materials, if present. When a conflict exists, use the stricter document.
9. Follow insurance underwriter's requirements acceptable for use with specified products or systems.
10. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
11. All kettles shall have an automatic thermostat control, and temperature gauge, all in working order.
12. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.
13. Surface and air temperatures should be a minimum 45° F during applications of cleaner and waterproof coating and remain above 45° F for a minimum of four (4) hours following applications. Verify compatibility of cleaner with coatings, paints, primers and joint sealers specified. Advise Owner's representative of any problems in this regard prior to commencing cleaning operations.
14. Temporary Sanitary Facilities: The contractor shall furnish and maintain temporary sanitary facilities for employees use during this project. These will be removed after the completion of the project. All portable facilities shall comply with local laws, codes, and regulations.

B. Protection of Work and Property:

1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations pertaining to asbestos as required shall be fulfilled by the contractor as part of his proposal.
2. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.
3. Twenty-four Hour Call: The contractor shall have personnel on call 24 hours per day, seven (7) days per week for emergencies during the course of a job. The Owner's Project Manager is to have the 24 hour numbers for the contact. Contractor must be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers available to the Owner's Project Manager are to be both home and office numbers for:
 - a) Job Foreman
 - b) Job Superintendent
 - c) Owner or Company Officer

C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage done to the building, equipment, or grounds must be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.

D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.

E. Use of Premises:

1. The contractor is advised that the Owner will occupy the building at all times, and the contractor must provide all safeguards required to protect personnel and to keep noise levels as low as reasonably possible for each operation.
2. The contractor shall:
 - a) Coordinate work in such a manner as to not interfere with the normal operation of the building.
 - b) Assume full responsibility for protection and safekeeping of products stored on premises.
 - c) Agree to hold the Owner harmless in any and all liability of every nature and description which may be suffered through bodily injuries, including death of any persons by reason of negligence of the contractor, agents, employees, or subcontractors.

F. Cleaning and Disposal of Materials:

1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. A suitable scrap chute or hoist must be used to lower any debris. At completion, all work areas shall be left broom clean and all contractor's equipment and materials removed from the site.
3. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
4. Debris shall be deposited at an approved disposal site.

1.09 WARRANTY

- A. Twenty (20) Year NDL Total System Warranty: The complete roofing system shall be guaranteed for a minimum of twenty (20) years from the date of Substantial Completion for this project. Guarantee responsibilities shall be as follows:
1. Roofing contractor shall guarantee the entire roofing system for a period of two (2) years from the date of Substantial Completion.
 2. The materials manufacturer shall guarantee the entire roofing system as supplied by system manufacturer for a total period of twenty (20) years from the date of substantial completion.
 3. Membrane manufacturer shall provide the written warranty as specified.
 4. The entire roofing system shall be guaranteed to be watertight and against any failures of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
 5. Warranty repairs shall be performed by a certified installer. The repairs shall be performed in accordance with the manufacturer's written instructions and recommended procedures so as to not void the warranty.
- B. During the proposal period each Contractor shall make arrangements with the materials manufacturer to provide the required warranty. Refer to SUBMITTALS paragraph in this section for requirements concerning submittals of warranty.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Compatibility: Provide materials that are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.
- B. Materials herein specified shall be supplied or approved in writing by the manufacturer issuing the warranty.
- C. The white polyester reinforced fleece backed adhered PVC with Elvaloy® roofing system shall only be applied by manufacturer approved and trained roofing contractors.

- D. The manufacturer shall have 15 years UL listing for the specified membrane to be used on the project. Membrane manufacturer shall have a minimum of 15 years FM approval, and 15 years manufacturing experience with the roofing membrane specified for this project.
- E. All roofing and roof accessories shall be installed in compliance with manufacturer's current specifications and details.
- F. All materials used on the project shall be asbestos free.

2.02 ROOFING MEMBRANE

- A. The white 67 mil polyester reinforced fleece backed PVC with Elvaloy® membrane shall have the following minimum physical properties, or prior approved equal.

<u>Property</u>	<u>Test Procedure</u>	<u>Physical Properties</u>
Color		White
Thickness	ASTM D 751	67 mil Nominal
Roll Size		76" x 90'
Breaking Strength	ASTM D 751	325 x 324 lbf
Tear Strength	ASTM D 751	89 x 109 lbf
Seam Strength	ASTM D 751	295 lbf
Elongation	ASTM D 751	50% x 42%
Heat Aging	ASTM D 3045	>90 %
Low Temp Bend	ASTM D 2136	Pass (-40° F)
Static Puncture Resistance	ASTM D 5602	Pass
Dynamic Puncture Resistance	ASTM D 5635	Pass
Permeance	ASTM E 96	0.003 Perms
Dimensional Stability	ASTM D 1204	0.3%
Weight Change after Water Immersion	ASTM D 570	1.20%
Accelerated Weathering	ASTM G 155	Pass
Fungi Resistance	ASTM G 21	No growth
Solar Reflectivity	ASTM C 1549	0.82 (white)
Emissivity	ASTM C 1371	0.91 (white)
Solar Reflectance Index (SRI)	ASTM E 1980	109 (white)
Underwriters Laboratory	Class A	Approved
Factory Mutual	Class 1-90	Exceeds
Thermoplastic Membrane	ASTM D 4434	Exceeds

2.03 FLASHING MEMBRANE

- A. The flashing membrane shall be a white PVC with Elvaloy® polyester reinforced flexible sheet, or prior approved equal.

<u>Property</u>	<u>Test Procedure</u>	<u>Physical Properties</u>
Color		White
Thickness	ASTM D 751	60 mil Nominal
Breaking Strength	ASTM D 751	298 x 278 lbf
Seam Strength	ASTM D 751	286 lbf
Tear Strength	ASTM D751	89 x 109 lbf
Elongation	ASTM D 751	35% x 34%
Heat Aging	ASTM D 3045	>90%
Static Puncture Resistance	ASTM D 5602	Pass
Dynamic Puncture Resistance	ASTM D 5635	Pass
Low Temperature Bend	ASTM D 2136	Pass @ -40°F
Permeance	ASTM E 96	0.003 Perms
Dimensional Stability	ASTM D 1204	0.3%
Wt. Change after Immersion	ASTM D 570	1.20%
Accelerated Weathering	ASTM G 155	Pass
Fungi Resistance	ASTM G 21	Pass
Solar Reflectivity	ASTM C 1549	0.82
Solar Emissivity	ASTM C 1371	0.91
Solar Reflectance Index (SRI)	ASTM E 1980	109
Underwriters Laboratory		Class A
Factory Mutual		Class 1-90

2.04 NON-REINFORCED MEMBRANE

- A. The non-reinforced membrane shall have the following minimum properties, or prior approved equal.
- Description: Non-reinforced thermoplastic white membrane, thickness approximately 45 mils.
 - Use: Inside/outside corners, multiangled intersections, sealant pockets and other conditions where molding of the membrane is required.

2.05 BITUMEN

- A. Shall be ASTM D 312 Type IV steep asphalt.

<u>Slope</u>	<u>Interply</u>	<u>Top Pour</u>	<u>Backnail</u>	<u>Strap</u>
0 - ½" per 12"	Type IV	Type IV	No	No
½" - 2" per 12"	Type IV	Type IV	Yes	Strap if Possible
2" - 3" per 12"	Type IV	Type IV	Yes	Yes

2.06 CAULKS

- A. Sealant for use at coping joints, reglet joints, etc., shall be a one-component urethane non-sag, gun grade sealant designed for use in active exterior joints, and shall meet or exceed Federal Specification No. 1 TT-S-00230C, Type II, Class A, ASTM C 920. Where joint surfaces are contained or are contaminated with bituminous materials, provide manufacturer's modified-type sealant (modified with coal-tar or asphalt as required), or approved equal.

- B. To seal the leading edge of the membrane, to bond membrane at terminations with metal, and for open seam repair, sealant shall be a thermosetting, solvent free, non-slump, self-fixturing, multipurpose structural sealant which shall meet the following physical and performance properties, M-1 as manufactured by Chem Link Inc., or approved equal.

Properties

Specific Gravity	1.62 (13.5 lbs./gallon)
Viscosity	800,000 cps Brookfield RTV, TF spindle, 4 rpm 70° F.
Shear Strength (ASTM D-1002)	300 psi+ (7 day ambient cure)
Elongation @ break (ASTM D-412)	300% (7 day ambient cure)
Hardness Shore A (ASTM C-661)	50 – 55 (14 day ambient cure)
Tack free time (ASTM C-679)	35 minutes
Low temperature flex	Minus 20° F: PASS
Slump (sag) (ASTM C-639)	Zero slump
Shrinkage (ASTM D-2453)	No measurable shrinkage (14 day cure)
Service temperature	-40° F to 200° F

2.07 UNDERLAYMENT PLIES

- A. Shall be Underwriters Laboratory approved and listed in the FM Global Approval Guide.
- B. Shall be SBS 80 mil SS base sheet, tested in accordance with ASTM D 5147, as approved by field membrane manufacturer, or approved equal.

2.08 INSULATION

- A. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved, and be listed in the FM Global Approval Guide.
- B. Polyisocyanurate Roof Insulation: Insulation shall be two (2) layers of rigid polyisocyanurate foam board; thickness and LTTR-value shall be a minimum of 4.5" = 25.0; meeting Federal Specification No. HH-I-1972/1 or 2 with 20 psi minimum compressive strength and 2.0 pcf minimum density. Board shall be surfaced on two (2) sides with non-asphaltic facer material.
- C. Tapered Polyisocyanurate Roof Insulation: Shall be tapered polyisocyanurate board per Federal Specification No. HH-I-1972/1 or 2, with a 20 psi minimum compressive strength and 2.0 pcf density minimum. Insulation shall be of thickness required for one-half inch (1/2") slope per foot for crickets and saddles to provide slope to roof drains and scuppers as shown on drawings. Insulation shall be surfaced on two (2) sides with a non-asphaltic facer material.
- D. Recovery Board: Impact-resistant, nonstructural, specially engineered gypsum and cellulose fiber panels with 95% recycled content; uniform water-resistance throughout core and surface. Board size four feet by eight feet (4' x 8'), thickness 1/2"; conforming to ASTM C 1278, meeting FM 4470 Class 1 criteria, classified by Underwriters Laboratory, and listed in the FM Global Approval Guide. Board will meet the following physical properties, Securock™ Roof Board, as manufactured by USG Corporation, or approved equal.

<u>Test</u>	<u>Typical Value</u>	<u>Test Method</u>
Fire Resistance	Class A	UL 790
Permeance	≤ 30	ASTM C473
Surface water absorption	≤ 1.6 nominal grams	ASTM C473
Water resistance	Maximum 10% weight percentage gain	
Mold Resistance	Minimum rating of "10"	ASTM D3273

2.09 FASTENERS AND PLATES

- A. General: All fasteners and plates for the installation of insulation, and for the installation of the membrane, shall be supplied and warranted by the membrane manufacturer for the specific application.
- B. Membrane attachment toggles, if required, shall be provided and warranted by the membrane manufacturer.
- C. All fasteners and plates shall be FM Global approved corrosion resistant screws or anchors supplied and warranted by the membrane manufacturer. Fasteners shall be of a type and length recommended by the manufacturer for fastening the insulation and/or protection layer (through the existing roof in reroofing) to the structural roof deck.

2.10 FASTENERS

- A. Fasteners and fastening plates or bars shall be listed in the FM Global Approval Guide, and be as recommended by the fastener manufacturer for the specific application.
- B. Fastener for Brick: Shall be one-fourth inch by two inches (1/4" x 2"), zinc with plated steel or stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
- C. Fastener for Steel Deck: Shall be a #14 fastener, fluorocarbon coated, with CR-10 coating. A minimum .200 diameter shank and .250 diameter thread. To be used with round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to thirty (30) Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses FM Global Approval Standard 4470, as manufactured by Olympic Manufacturing Group, Inc., or approved equal. Fasteners, plates, and/or bars shall be listed in the FM Global Approval Guide.

2.11 BONDING ADHESIVE FOR FLASHING

- A. Description: Adhesive is a bonding cement of synthetic rubber for fully adhering membranes to various substrates, produced by Ashland Chemical, or approved equal.

<u>Typical Liquid Properties (Room Temperature)</u>		
Color	Amber/Yellow	
Base Product	Neoprene	
Solids	25%	
Specific Gravity	.87	
Pounds/Gallon	7.25	
Viscosity (CPS)	2500	
Solvents	Ketone, Toluene, Aliphatic Hydrocarbon, Zylene	
Estimated Coverage		
2 Sided Application	55/70 sq. ft. (2/2.5 mils dry)	
DOT Label Required	Flammable Liquid	
Code - 584661		

- B. Handling: Contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

2.12 ASPHALT ROOF PRIMER

- A. Quick-dry asphalt-based primer for priming of asphalt roof surfaces, or prior approved equal.

Applicable Federal Specification	SS-A-701B
ASTM	D 41
Flash Point	105° F
Viscosity at 80° F (ASTM D 217)	50-60 K.U.
Weight per gallon	7.4 pounds
Drying time (to touch)	Min. 4 hours

2.13 CANT STRIP

- A. Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, FM Global and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.

2.14 WOOD

- A. All nailers, cants and wooden curbs shall be fire rated, treated lumber as required by NRCA, FM Global and Underwriters Laboratory guidelines.

2.15 TRIM STRIP

- A. The trim strip shall have the following minimum properties, or prior approved equal.
1. Six inch (6") wide non-reinforced 45 mil thermoplastic used for capping butted ends of rolls.
 2. The trim strip is seamed with the use of hot-air welding.

2.16 CORNERS

- A. Inside and outside corners shall be supplied by the membrane manufacturer and shall be of the same base material as the roof membrane.

2.17 PIPE BANDS

- A. Stainless steel bands with self-locking heads.
- B. Tighten with hand tool for tension control and flush cut off.

2.18 PRE-MOLDED BOOTS

- A. Non-reinforced thermoplastic tapered molds for various pipes, heat welded to field membrane and sealed at top with stainless steel pipe bands and seam sealer.

2.19 PITCH PAN SEALANT

- A. Shall be one-part, self-leveling polyurethane sealant meeting Federal Specification No. TT-S-00230C, Type I, Class A, ASTM C 920, Type S, Grade P, Class 25, for use in new pitch pans, or prior approved equal.

2.20 PIPESTANDS (6" OR SMALLER - LESS THAN 9" OFF ROOF SURFACE)

- A. Black, polycarbonate construction with stainless steel roller pin assembly suitable for gas lines and conduit set in finished roof assemblies, Model No. 24R, sized accordingly, as manufactured by Miro Industries, Inc.

2.21 LEAD FLASHING DRAINS

- A. Shall be four pound (4#) lead, minimum thirty-six inches by thirty-six inches (36" x 36"), used for flashing of internal drains.

2.22 WALKWAY PAD

- A. The walkway pad shall have the following minimum physical properties, and be applied with edges heat or solvent welded, or prior approved equal.

<u>Property</u>	<u>Test Procedure</u>	<u>Physical Properties</u>
Color		Gray
Size		36" wide x 60' long
Thickness	ASTM D 638	.080" nominal
Reinforcement		1000 Denier Polyester
Tear Strength	ASTM D 751	210 X 200 lbf
Puncture Resistance		96 lbs
Cold Resistance	ASTM D 1043	-40° C
Shore A Durometer		85
Hydrostatic Resistance		400 psi
Dimensional Stability	ASTM D 1240	≤ 1%
Ultraviolet Stability		12,000 hrs. Excellent

2.23 TERMINATION/PRESSURE BARS

- A. Aluminum strip shall be extruded channel bar with a mill finish, width one inch (1"), thickness 0.100" ± .008", leg height one-fourth inch (1/4") top and bottom, leg angle ninety degrees (90°), for perimeter and curb anchorage, having predrilled holes six inches (6") on center, as manufactured by Olympic Fasteners, or approved equal.

2.24 T- JOINT COVERS

- A. Supplied by the membrane manufacturer as a secondary covering to all T – Joints in the installation of thermoplastic roof systems consisting of waterproofing coverings equal to or greater than 60 mils in thickness.

2.25 VERTICAL WALL SHIMMING MATERIAL

- A. Shall be one of the following unless otherwise accepted by Owner's representative: OSB, exterior grade plywood, gypsum core board or concrete core board. Proper selection of material is required to achieve FM Global and UL guidelines.

2.26 SELF-ADHERING UNDERLAYMENT FOR TEMPORARY WATERPROOFING

- A. A premium heavyweight, minimum 60 mil, self-adhering underlayment, to use as a temporary waterproofing barrier.

2.27 OVERNIGHT SEAL

- A. Hot applied asphalt bitumen shall be provided for the purpose of night sealing the roof system.

2.28 DELIVERY AND STORAGE

- A. All materials shall be delivered with appropriate carton and can labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

2.29 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

2.30 MISCELLANEOUS MATERIALS

- A. Other materials shall be as specified or of the best grade for the proposed use as recommended by the manufacturer.

PART 3 - EXECUTION

3.01 REFERENCE

- A. The manufacturer's Technical Specifications shall be considered a part of this specification and should be referred to for more specific application procedures and recommendations.
- B. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.
- C. General Installation:
1. Protect adjacent areas with tarpaulin or other durable materials.
 2. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
 4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. Any prefabricated sheet steel that is to receive bitumen, or come in contact with bitumen or adhesive, shall be scored, scuffed or abraded prior to receiving primer.

5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
6. All surfaces/substrates shall be clean and dry prior to application of materials.
7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the insulation and/or substrate. Gravel or debris between the insulation/substrate and plies is not acceptable.
8. Bitumen kettle shall have a visible thermometer and thermostatic control or some other means to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions.
9. Ambient temperature shall be 45° F and rising.
10. The maximum heating temperature of Type IV asphalt shall be 500° F.
11. The temperature of Type IV asphalt shall be approximately 430° F ± at the point of application or as recommended by the membrane manufacturer.
12. Maintain kettle and/or tanker temperature at least 25° F below the actual flash point of the bituminous materials used.
13. Never heat the bituminous materials at high temperatures for prolonged periods of time.
14. Do not allow bituminous materials to stand in luggers for long periods.
15. Circulate bituminous materials.
16. Insulate hot transport lines if required.
17. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying membrane.
18. Where deteriorated base flashing is removed, primed cant strips shall be installed at the intersection of the deck and the vertical surfaces. All flashings shall be mechanically top-fastened with a termination bar a minimum of six inches (6") on center at the top leading edge, and be a minimum of eight inches (8") in height from finished membrane.
19. Provide a water test of each roof section prior to substantial completion. The test should simulate rainfall of one inch (1") per hour minimum.
20. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

3.02 SUBSTRATE PREPARATION

- A. New Construction: Substrate shall be smooth and free of debris, sharp edges, and other surface irregularities prior to work starting. Substrate repair shall be performed as required to minimum of NRCA standards.
- B. Metal Decks – New Construction:
 1. All loose rust, bitumen, or other foreign material shall be removed from the deck before applying asphalt primer at the minimal rate of one and one-half (1-1/2) gallons per one hundred (100) square feet of area.
 2. The deck span shall not exceed that recommended by FM Global Bulletin 1-28.
 3. Expansion/control joints shall be installed so that no one area exceeds two hundred feet by two hundred feet (200' x 200').

3.03 INSULATION

- A. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application. Installation must meet ASCE 7 criteria and meet local governing building codes.

- 1
2 B. Precautions: The surface of the insulation must not be ruptured due to overdriving of
3 fasteners.
4
5 C. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints
6 staggered and butted as close as possible. All joints shall be tight and at the roof perimeter
7 and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a
8 minimum. All openings one-fourth inch (1/4") or larger shall be filled with insulation.
9
10 D. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if
11 applicable).
12
13 E. No more insulation shall be installed than can be covered by the completed roof system by
14 the end of the day or the onset of inclement weather.
15
16 F. Tapered insulation and crickets, when specified, shall be placed in accordance with the
17 drawings and/or as required to minimum of NRCA standards.
18

19 3.04 MECHANICALLY FASTENED INSULATION
20

- 21 A. Specified thermal insulation shall be loose laid in two layers using off set joints, so that each
22 layer breaks joints to a minimum of six inches (6") both ways with the preceding layer. Then
23 the specified cover board shall be laid over the thermal insulation, breaking joints a minimum
24 of six inches (6") both ways with the preceding layer and mechanically fastened to conform
25 to the ASCE 7 criteria for wind uplift as dictated by wind zone applicable to location of
26 project. Fasteners and fastening patterns shall be determined by building height, location
27 and geographical area of the United States. It is the contractor's responsibility to consult
28 current publications, literature, and bulletins of IBC and the manufacturer that are in effect at
29 the time of this project. Boards shall be staggered and butted as close as possible with
30 voids over one-fourth inch (1/4") to be filled.
31
32 B. Insulation shall be laid with edges parallel to flutes and bearing on deck surface/flats. The
33 long dimension of base insulation layer must be fully supported by the top flange of the
34 metal deck. The edges of insulation boards must not cantilever over the flutes of the metal
35 deck.
36

37 3.05 NAILERS
38

- 39 A. Wooden nailers shall be installed at parapets, drip edges, and expansion joints on outside
40 perimeter of building according to NRCA, Underwriters Laboratory and IBC guidelines.
41
42 B. All Construction: Nailers shall be the same height as the new insulation and cover board
43 being installed where required. Nailers shall be raised if necessary by anchoring an
44 additional nailer of appropriate height to the existing nailer if the existing nailer is not to be
45 replaced. Nailers shall be anchored to resist a pull-out force of one hundred seventy-five
46 pounds (175#) per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at
47 three feet (3') on center maximum. Expansion joint nailers shall extend upward a minimum
48 of eight inches (8") above finish roof height.
49

3.06 WOOD CANTS

- A. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory and IBC guidelines.

3.07 APPLICATION OF BASE SHEET

- A. Cover Board shall be covered with SBS 80 mil SS base sheet and adhered as follows:

All layers shall be solid mopped at the nominal rate of thirty pounds (30#) \pm 20 percent per one hundred (100) square feet using asphalt Type III as required by slope, properly heated. Specified layers shall be applied in accordance with the manufacturer's recommendations and in accordance with general practices as set forth by the NRCA Roofing Manual.

1. (Note: Base sheet shall not be left exposed to the elements for more than 14 days.)

3.08 HOT APPLIED FLEECE BACKED MEMBRANE

- A. Fully Adhered Application: Fully adhere membrane to acceptable substrate with hot asphalt applied at the rate specified by the manufacturer.

1. The roof surface must be clean, dry and free of foreign material.
2. Position sheets as indicated on approved shop drawings.
3. Fold one end of the Elvaloy® sheet on top of itself until both ends meet. Apply hot asphalt to the prepared roof surface. The sheet can then be pulled and laid into the bonding material using care not to create any wrinkles.
4. Carefully push into place from fold line to overlap, avoiding wrinkles and air pockets. Roll or broom membrane flat.
5. Repeat procedure for other sheet half.
6. Lap seams shall be done by lapping the two inch (2") selvedge edge over the non-selvedge edge of the previous roll. The selvedge edge seam shall be made with the heat gun method.
7. Roll ends are butted together and capped with a six inch (6") wide trim strip. The trim strip is then seamed with the heat gun.
8. T-Joint covers are required over all t joints on installations of thermoplastic roofing membranes equal too or greater than 60 mils in thickness. Center T-Joint cover over the t-joint and completely hot air weld the cover to the field membrane.

- B. Lap Seaming Procedure: Overlap membrane for attachment method specified and hot-air welded with manufacturer's approved equipment.

1. All surfaces to be weld shall be clean, dry and free of foreign material.
2. All seams must then be checked with a needle probe and any voids repaired with the heat gun.

3.09 FLASHING

- A. Flash all penetrations, metal edge systems, walls, curbs, expansion joints, drains as shown on details and approved shop drawings with white reinforced Elvaloy® flashing membrane.

1. Use prefabricated flashing accessories or components such as sealant pockets, premolded vent/pipe flashing.
2. Mechanically fasten flashing at terminations according to approved details.
3. Fastening membrane flashing through metal counterflashing is not acceptable.

- B. Any lumber or shimming required for attachment or to make material flashing flush or level with offsets and/or transitions shall be incorporated in the flashing specifications.

3.10 BASE FLASHING (APPROXIMATELY 8" IN HEIGHT MINIMUM)

- A. Base flashings shall be installed using the flashing membrane, with length of run not to exceed twenty linear feet (20').
- B. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck.
- C. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.
- D. The roofing field membrane shall extend up over and two inches (2") above the top of cant strips at all vertical intersections or out to the roof's edge.
- E. All existing substrates receiving flashing membrane shall be clean and primed with primer, prior to application as required.
- F. All base flashings shall be mechanically fastened with a termination bar a maximum of six inches (6") on center, be a minimum of eight inches (8") above finished roof height, extend a minimum of four inches (4") onto the field of horizontal roof membrane, and not exceed twenty linear feet (20') of run in length.
- G. All vertical flashing lap seams of the flashing membrane shall be hot-air welded.
- H. All flashing membrane shall be adhered with flashing bonding adhesive to the vertical substrate and hot-air welded to the field of roof membrane; hot-air weld vertical laps.
- I. Flashing laps shall be minimum two inch (2") width, no maximum. Hot-air weld of flashing lap shall be minimum two inch (2") width, no maximum.
- J. Hot-Air Welding of Flashing Laps:
1. When using a hand-held hot-air welder, the seams should be pressed together using a hand-held roller. The speed and temperature settings of the welding equipment can be affected by the weather conditions at the site of application, therefore, these parameters should be set by trial and error using two (2) pieces of the flashing membrane. Minimum width of hot-air weld two inches (2"), no maximum.
 2. Lay the laps together and apply pressure to the welded seam to ensure full adhesion.
 3. Allow the seams to set fully, and probe the entire length for voids. Reseal voids immediately with a hot-air gun and roller.
- K. All hot-air welded seams/laps shall be tested daily with a probe for integrity, no variance.

3.11 VERTICAL WALL FLASHING (FOR USE APPROXIMATELY 8-18" ABOVE THE FINISHED ROOF LINE AND EXTENDING UPWARD)

- A. Flashing membrane shall be installed on the vertical beginning a minimum of eight inches (8") above the finished roof line (where the base flashing is terminated), with length of run not to exceed ten feet (10'). Flashing shall be installed in strict accordance with the manufacturer's recommendations.

- 1
2 B. All existing substrates receiving flashing membrane shall be clean and primed with asphalt
3 primer, prior to application.
4
5 C. All substrates receiving welded-seam flashing membrane shall be clean and primed with
6 primer, prior to application when applicable.
7
8 D. The vertical wall flashing membrane shall be set in flashing bonding adhesive according to
9 manufacturer's guidelines.
10
11 E. All vertical flashing lap seams of the flashing membrane shall be hot-air welded.
12
13 F. Flashing laps shall be minimum two inch (2") width, no maximum. Hot-air weld of flashing
14 lap shall be minimum two inch (2") width, no maximum.
15
16 G. Immediately following the laying of the flashing membrane, it shall be pressed or rolled in the
17 width direction of the membrane. This will prevent excessive entrapment of air beneath the
18 membrane. The pressing or rolling shall be in the width direction and with the laps so as not
19 to buck the laps.
20
21 H. Any flashing extending further than eighteen inches (18") up onto a vertical surface shall be
22 installed using a termination bar secured at six inches (6") on center at the mid-point and not
23 to exceed forty eight inches (48") on center vertically and the membrane shall be extended
24 up and over the parapet wall and fastened to the nailer on the outside of the wall. The
25 termination bar(s) shall be covered with a eight inch (8") wide trim strip stripping membrane
26 and hot air heat welded to the wall flashing membrane.
27
28 I. The flashing membrane shall be run up the wall in sheet widths acceptable to the
29 manufacturer, and run under the coping cap and be terminated on the outside of the wall six
30 inches (6") on center; then the coping cap shall be reset. All side laps are to be hot-air
31 welded.
32
33 J. Hot-air Welding Laps:
34 1. When using a hand-held hot-air welder, the seams should be pressed together using a
35 hand-held roller. The speed and temperature settings of the welding equipment can
36 be affected by the weather conditions at the site of application, therefore, these
37 parameters should be set by the contractor by using two (2) pieces of flashing
38 membrane. Minimum width of hot-air weld shall be two inches (2").
39 2. Lay the laps together and apply pressure to the welded seam to ensure full adhesion.
40 3. Allow the seams to set fully, and probe the entire length for voids. Reseal voids
41 immediately with a hot-air gun and roller.
42
43 K. All hot-air welded seams/laps shall be tested daily with a probe for integrity, no variance.
44
45 L. Any lumber or shimming required for attachment or to make material flashing flush or level
46 with offsets and/or transitions shall be incorporated in the flashing specifications.
47

48 3.12 PERIMETER FASTENING
49

- 50 A. Wood nailers are required for perimeter gravel stops or drip edges. Field membrane and all
51 plies shall be mechanically fastened to nailer on twelve inch (12") centers maximum.

3.13 EDGING FLASHINGS

- A. An NRCA-approved edge/fascia or coping system shall be installed in strict accordance with published instructions to meet ES-1.

3.14 ROOF DRAINS

- A. Inspect and test drain and drain lines prior to start of work in contact area. Open if blocked or clogged and repair/replace all broken, missing drain components and lines as required. Verify in writing that all drains and lines are free flowing and watertight prior to substantial completion. Comply with local plumbing codes.

3.15 WALKWAY PADS

- A. Fully adhere and heat weld walkway pads where shown on drawings or where required to provide protected pathways from rooftop access points to mechanical or other equipment requiring rooftop maintenance.

3.16 CLEANING

- A. Clean exposed surfaces of excess cement, adhesive, sealants, mortar and paint associated with the new work.
- B. Clean work area of excess roofing materials and installation debris daily.
- C. Repair or replace defaced or disfigured finishes caused by the work.

3.17 MEMBRANE CLEANING

- A. After all membrane has been installed, it shall be cleaned with a cleaning agent compatible with the membrane to return the membrane to like new appearance.

3.18 PROTECTION

- A. Protect all building surfaces against damage from roofing work.
- B. Where traffic must continue over finished, installed roofing system, protect membrane, underlayment accessories and finishes from damage.

3.19 MEMBRANE PROTECTION

- A. Where equipment pads, wood sleepers, or walkway slabs are to be installed over the roofing membrane, an additional layer of the roofing membrane shall be installed between the roofing membrane and the pad, sleeper, or slab. Due caution shall be exercised to prevent roofing membrane damage during placement. Where required, membrane shall be welded to field membrane to prevent slippage.

1 3.20 PIPING/CONDUIT

2
3 A. Piping/conduit shall be raised to NRCA recommended heights, and new supports furnished.
4 Permanent supports shall be installed upon pads approved by membrane manufacturer.
5 Coordinate work with Owner's representative.

6
7 B. All gas lines, piping, and conduits shall be coated with industrial grade yellow paint.
8

9 3.21 PIPE/EQUIPMENT SUPPORTS

10
11 A. Pipe supports shall be placed approximately ten feet (10') on center. New supports shall be
12 set on a double layer of membrane, and attached to the pipe with suitable strapping.
13 Double layer of membrane shall be adhered to the roof surface.

14
15 B. Gas lines three inches (3") and over must be supported on wood block with pipe roll stands.
16

17 3.22 OVERNIGHT SEAL

18
19 A. Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing
20 Manual, SPRI and membrane manufacturer's recommended procedure.

21
22 B. The roofing membrane shall be sealed to the roof deck or existing roof at the end of the
23 day or at the onset of inclement weather to prevent water from flowing into the completed
24 roofing system. Temporary seals shall be removed upon resumption of work.
25
26

27 **END OF SECTION 07 54 19**

SECTION 07 62 00
SHEET METAL AND MISCELLANEOUS ACCESSORIES
FOR FULLY ADHERED MULTI-PLY ROOF SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide flashing and sheet metal components for moisture protection.
2. Related accessories.

1.02 SUBMITTALS

A. Product Data:

1. Submit shop drawings, product data and mockups of all sheet metal.

1.03 QUALITY ASSURANCE

- A.** Comply with governing codes and regulations. Provide products of acceptable manufacturers in satisfactory use in similar service for five (5) years. Use experienced installers. Deliver, handle and store materials in accordance with manufacturer's instructions.

- B.** Reference Standards: Applicable portions of ASCE, SMACNA, ASTM and NAAMM publications.

1.04 WARRANTIES

- A.** Manufacturer's Product Warranty: Submit manufacturer's standard limited product / warranty signed by the manufacturer's authorized official, guaranteeing to correct failures in product which may occur during the warranty period, without reducing or otherwise limiting any other rights to correction which the Owner/Project Consultant may have under the contract documents. Failure is defined to include product failure which leads to interruption of a watertight installation. Correction may include repair or replacement of failed product.
- B.** Contractor's Warranty Period: For roofing flashing and sheet metal, provide a written warranty which shall warrant work to be free of leaks and defects in materials and workmanship for two (2) years, starting from date of substantial completion.
- C.** Defects of the sheet metal occurring during the warranty period shall be promptly corrected by the contractor, and defects of the roofing shall be promptly corrected by the manufacturer at no additional cost to the Owner. Upon notification from the Owner or the Owner's representative that evidence of a defect exists, the responsible party shall immediately inform the Owner's representative of the date on which corrective work will be scheduled, and shall notify the Owner's representative when the corrective work has been completed.

PART 2 - PRODUCTS

2.01 SHEET METAL MATERIAL

- A. Hot-dipped Galvanized Steel for use as counterflashings (where not visible from the ground) and expansion joints: Minimum 24-gauge, G-90, hot-dipped galvanized metal, commercial quality, ASTM A 525.
- B. Elvaloy® Cladded Metal for Pitch Pans: Shall be G-90 galvanized steel with 25 mil Elvaloy® membrane.
- C. Elvaloy® Cladded Metal: Shall be G-90 galvanized steel with 25 mil Elvaloy® membrane lamination; width shall be four feet (4'), length shall be eight feet (8') or ten feet (10').
- D. Hot-dipped Galvanized Steel for use as continuous clips: Minimum 22-gauge, G-90, hot-dipped galvanized metal, commercial quality, ASTM A 525.
- E. Prefinished Galvanized Sheet Steel (where visible from the ground): Shall be 24-gauge flat stock, prefinished with Kynar finish meeting ASTM A 446, forty-five and one-half inches to forty-eight inches width by one hundred twenty inches in length (45-1/2" - 48" x 120") for use as new metal edge gravel guard, downspouts, gutters, coping and miscellaneous metal.
- F. Stainless Steel: QQ-S-766, Class 301, 302, 304, or 316; or ASTM A 167, Type 301, 302, 304, or 316; form and condition most suitable for the purpose.
- G. Aluminum and Aluminum Alloy Plate and Sheet: QQ-A-250; form, alloy, and temper shall be that most suitable for the purpose.
- H. Sheet Lead: QQ-L-201, Grade B.
- I. All existing sheet metal shall be replaced with new metal of like gauge and type, or as specified on drawings.
- J. All prefinished metal color shall be as selected by Owner/Architect from manufacturer's full range of colors, including metallics.

2.02 FASTENERS

- A. Fasteners shall be same metal as flashing/sheet metal, or other non-corrosive metal as recommended by sheet manufacturer for the specific application. Match finish of exposed heads with material being fastened.
- B. Fasteners and fastening plates or bars shall be listed in the FM Global Approval Guide.
- C. Fastener for Brick: Shall be one-fourth inch by two inches (1/4" x 2"), zinc with plated steel or stainless steel nail, one piece unit, flat head.
- D. Screws: Self-taping sheet metal type with neoprene washer, as appropriate.
- E. Pop Rivets: Full stainless steel Series 42 or 44, as appropriate.

- F. Continuous Clip: Concealed hold-down clip type; of same materials as coping, gravel guard, sized to suit application. Use a continuous clip, minimum 20-gauge G-90 galvanized.

2.03 RELATED MATERIAL

- A. Plastic Cement: FS SS-C-153, cutback asphalt type.
- B. Solder: QQ-S-571 composition best suited for purpose; use high tin content, minimum 60/40, for stainless steel and monel alloy.
- C. Solder: For use with galvanized steel or copper, provide 50-50 tin/lead solder (ASTM B 32), with rosin flux.
- D. Copper, Sheet, and Strip: QQ-C-576, ASTM B 370, light cold-rolled temper, minimum 16 ounce.
- E. Sealant (for Sheet Metal): One-component polyurethane, conforming to requirements of FS TT-S-230C, non-staining and non-bleeding.
- F. Miscellaneous Materials:
1. Downspout Boots: Provide and install cast iron by Neenah Foundry Company, or pre-approved equal.
 2. Splash Blocks: Concrete, 3000 psi, 28 days. Provide and install with protection pads at all downspouts. Dimensions shall be a minimum eighteen inches wide by thirty-six inches long (18" x 36").
 3. Metal Accessories: Provide and install sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size, and gauge required for performance.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, substrates are smooth and clean and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed and secure.
- C. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

- A. Field measure site conditions prior to fabricating work. Provide all shop drawings and mock-ups one month prior to installation to the Owner/Project Consultant for approval.
- B. Install starter and edge strips and cleats before starting installation.

3.03 FABRICATION - GENERAL

- A. Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer's instructions and recommendations. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
- B. Fabricate gravel stops/fascia, gutters/downspouts, counterflashings, expansion joints, and copings with new galvanized sheet metal as specified. Fabricate gravel guard and fascia to size and dimensions as indicated on the drawings. Fabricate light metal coping, gutters and downspouts as indicated.
- C. Fabricate pitch pans with PVC with Elvaloy® clad metal as specified.
- D. Form sheet metal on bending brake.
- E. Form materials with straight lines, sharp angles and smooth curves.
- F. Fold back edges on concealed side of exposed edge to form hem (1/2" minimum).
- G. Weld or solder joints on parts that are to be permanently and rigidly assembled.
- H. Limit single-piece lengths to ten feet (10').
- I. Fabricate corner pieces with eighteen inch (18") extensions, mitered and sealed by forming as one piece.
- J. Where installing flashing directly to masonry or dissimilar materials, backpaint with bituminous paint
- K. Install new metal rooftop projections. New rooftop projection details shall be as recommended in NRCA or SMACNA handbooks. All rooftop projections shall be cleaned, all joints sealed, and painted with a rust inhibitive paint.
- L. All sheet metal shall be sealed and watertight.
- M. Metal work should be secured so as to prevent damage from buckling or wind. Where clips are shown, these are to be continuous.
- N. All metal to receive bitumen or adhesive shall be first primed with asphalt primer.
- O. All prefinished metal shall be sanded and/or abraded prior to receiving primer.
- P. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

- Q. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

3.04 INSTALLATION

- A. General: All sheet metal termination to vertical wall shall have a through-wall with receiver installed on masonry walls or prefabricated "Z" bar flashing pre-installed to fluid applied wall finished prior to installation of sheet metal termination. This applies to edge metal, base flashing closures and all vertical surface intersections. Refer to NRCA, SMACNA, and metal manufacturer's guidelines.

- B. Elvaloy® clad metal shall be fabricated as needed; follow these specifications and standard sheet metal practice for attachment to roof details.

C. Edge Metal/Fascia:

1. Shall be installed with expansion joints, ten feet (10') on center, one-fourth inch (1/4") expansion leeway, with a cover plate.
2. Secure metal flashings per specifications.
3. Lock seams and end joints.
4. Form sections identical to profiles as shown or approved similar, to match existing building.
5. Fabricate corner pieces with minimum eighteen inch (18"), maximum forty-eight inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
6. Hem exposed edges one-half inch (1/2") minimum.
7. Backpaint flashing in contact with masonry or dissimilar materials with bituminous paint. Surface sand before applying primers.
8. Integrate flashing in a manner consistent with detailing.
9. Provide and install continuous clip around perimeter.
10. Shall be fabricated in accordance with all SMACNA provisions.

D. Coping:

1. Install new pre-manufactured metal coping for a permanent watertight installation.
2. All coping shall be pre-manufactured to include low profile standing metal seam to meet ES-1 requirements.
3. Shall be minimum 24-gauge prefinished Kynar installed in ten foot (10') sections maximum.
4. Vertical fascia shall extend minimum two and one-half inches (2-1/2") or be minimum one and one-half inches (1-1/2") below bottom of nailer, whichever is greater.
5. Fabricate corner pieces with minimum eighteen inch (18"), maximum forty-eight inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
6. Hem exposed edges one-fourth inch (1/4") minimum.
7. Provide and install continuous clip, minimum 22-gauge.
8. Shall be fabricated in accordance with published details.

E. Expansion Joint Field and at Wall:

1. Shall be as outlined by details, and be in full compliance with these specifications.
2. Lock seams and end joints.
3. Fabricate corner pieces with minimum eighteen inch (18"), maximum forty-eight inch (48") extensions, formed and sealed with rivets and sealant, as one piece.
4. Hem exposed edges one-fourth inch (1/4") minimum.

5. Backpaint flashing in contact with masonry or dissimilar materials with bituminous paint. Surface sand before applying primers.
 6. Integrate flashing in a manner consistent with detailing.
 7. Provide and install continuous clip, minimum 22-gauge or one gauge thicker than flashing.
 8. Shall be fabricated in accordance with published details.
- F. Counterflashing:
1. Provide and install new metal counterflashing as required for a permanent watertight installation.
 2. Saw cut brick mortar joint to receive friction fit reglet and removable counterflashing as detailed in SMACNA Figure 4-4E.
- G. Primary and Overflow Scupper:
1. Fabrication:
 - a) Fabricate scuppers, collector head and downspout of profile and size indicated, taking care that the roof drain leader fits properly into the back of the collector head. Seal the pipe to the collector head for watertightness.
 - b) Field measure site conditions prior to fabricating work.
 - c) Fabricate with required connection pieces.
 - d) Fabricate section square, true, and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or performance.
 - e) Hem exposed edges of metal.
 - f) Form and seal all metal joints; provide for expansion joints per SMACNA.
 2. Installation:
 - a) Install collector head, downspout, and accessories at primary scupper only.
 - b) Join lengths with seams pop riveted and sealed watertight. Flash and seal collector head to downspouts and accessories.
 - c) Seal all metal joints watertight for full metal surface contact.
 - d) Collector Head: SMACNA style profile; submit detail for approval.
 - e) Downspouts: Rectangular profile. Seal all joints, six inches by six inches (6" x 6").
 - f) Support Brackets, Joint Fasteners: Profiled to suit gutters and downspouts.
 - g) Anchorage Devices: SMACNA requirements. Type recommended by fabricator.
 - h) Collector Head Support: Kynar.
 - i) Downspout Supports: Straps, Kynar.
- H. Pitch Pans:
1. Install pitch pans of 24-gauge, G-90 galvanized steel with a 25 Mil Elvaloy® Kee membrane lamination according to NRCA standards, minimum of six inches by six inches (6" x 6").
 2. Pitch pans shall be fabricated to a minimum of six inches (6") above the finished roof membrane. The top vertical edge of the thermoplastic clad metal must be folded over to conceal the uncoated side of the metal inside the pitch pan. The pitch pan flange must be a minimum of three and one half inches (3.5") wide in contact with the horizontal roof plain or field of roof membrane.
 3. Approved caulking or water block shall be applied under the pitch pan flange prior to securing the flange to the deck with approved fasteners a minimum of 4" on center.

4. Projection enclosed in pitch pans shall be cleaned in any manner suitable and coated with a rust inhibitive coating as approved by the Owner/Project Consultant. Coating shall be allowed to dry prior to pitch pan fill. MAXIMUM ONE PROJECTION PER PITCH PAN. NO EXCEPTIONS.
5. Base of pitch pans shall be filled with grout or cementitious binder to proper height and allowed to cure.
6. Top finish fill shall be self-leveling, one-part urethane, with maximum fill to within three-eighths inch (3/8") of top of pitch pan sides.
7. Strip the thermoplastic clad metal flange of the pitch pan to the field membrane with one strip of flashing membrane. The flashing membrane must extend from the outer edge of the pitch pan flange onto the field membrane a minimum of three inches (3") and butt to the vertical sides of the pitch pan on all 4 sides. The flashing membrane shall be hot air welded to the thermoplastic clad metal pitch pan and to the field membrane. Hot air welds shall be a minimum of two inches (2") wide.
8. Install preformed outside corners by hot air welding in place at all four (4) corners of the pitch pan.
9. Apply seam sealer to the edges of the flashing membrane.

I. Bonnets/Hoods:

1. Fabricate and install above all pitch pans, where necessary, or reinstall as applicable, metal bonnets over all pitch pans, NO EXCEPTIONS.
2. Bonnets/Hoods shall be manufactured with metal compatible with metal to which bonnet is to be attached.
3. On beams and other steel, weld in place bonnets fabricated from one-fourth inch (1/4") steel plate.
4. Draw band bonnets fabricated from 22-gauge galvanized steel may be used on circular projections.

3.05 FINISH

- A. Backpaint concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals. Exposed surfaces to be provided with a factory applied fluorocarbon Kynar finish meeting ASTM A 446 and AAMA specification 605.2 for high performance coating.
- B. New 24-gauge hot-dipped galvanized metal shall be painted on all locations visible from the ground with an industrial grade paint as selected by Project Manager/Architect from manufacturer's full range of colors, including metallics. Galvanized metal surface must be properly prepared by removing all oil, grease, and/or protective mill coatings by solvent cleaning surface in accordance with SSPC-SP1, and according to paint manufacturer's recommendation, to ensure proper adhesion of paint to metal.

END OF SECTION 07 62 00

ROOF PLANS/DETAIL DRAWINGS

1.01 ROOF PLANS

- A. Any drawings supplied are for reference purposes only. Dimensions, penetrations, curbs, etc. must be field verified. Those shown are typical but may not be all inclusive, and contractor shall be responsible for the correctness of same. Any existing insulation thickness, deck type or other details shown on the drawings shall be subject to contractor confirmation.

1.02 DETAIL DRAWINGS

- A. The enclosed details for this project are intended primarily to present the proper installation of the membranes used for waterproofing at flashings, perimeter closures, roof projections, etc. Specific underlying construction configurations, such as walls, nailers, wood backing, structural steel, etc., which may currently be in place may or may not be accurately depicted on the attached details. Unless specifically called out in the accompanying written specifications, or where a detail is noted "AS DRAWN", and/or proper roofing and construction practices are not being followed, underlying construction configurations are to remain unchanged from those in place on the building prior to this reroofing.

END OF SECTION

SECTION 08111
STOCK HOLLOW METAL WORK

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Provide all standard and non-standard steel doors and steel door and window frames, complete in place, not specifically described in other Sections of these Specifications but indicated on the Drawings or otherwise required for a complete and operable facility.
- B. Related work described elsewhere:
1. Wood doors: Section 08210

1.02 QUALITY ASSURANCE:

- A. Standards: Comply with standards specified in this Section as listed in Section 01085. NAAMM Standard HMMA 861 Guide Specifications.
- B. Qualifications of manufacturer: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.
- C. Qualifications of installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- D. Single source: All work of this Section shall be produced by a single manufacturer unless otherwise approved by the Architect.
- E. All Steel Doors and Frames provided shall be an acceptable assembly as outlined in the Texas Department of Insurance Product Evaluation Index (this index can be found in the web at www.TDI.STATE.TX.US/COMPANY.WIND.PROD.INDEX.HTML)

1.03 SUBMITTALS:

- A. General: Comply with provisions of Section 01300.
- B. Manufacturers' data: Within 45 calendar days after award of the Contract, submit:
1. Complete materials list of all items proposed to be furnished and installed under this section.
 2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
 3. Shop Drawings showing details of each frame type, elevations of each door design type, details of all openings, and all details of construction, installation, and anchorage.
 4. Manufacturer's recommended installation procedures.

The manufacturer's recommended installation procedures, when approved by the Architect, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

1.04 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

Part 2: PRODUCTS

2.01 MATERIALS

- A. Hot rolled steel sheets and strips: Commercial quality carbon steel, pickled and oiled, complying with ASTM A569 and ASTM A568.

- B. Cold rolled steel sheets: Commercial quality carbon steel, complying with ASTM A366 and ASTM A568. Interior Doors: 18 gauge; Exterior Doors: 16 gauge.
- C. Galvanized-steel sheets: Zinc-coated carbon steel sheets of commercial quality; complying with ASTM A526, with ASTM A525, G60 zinc coating mill phosphatized; for all doors and frames, zinc coat of not less than 0.10 oz./S.F.
- D. Supports and anchors: Fabricate of not less than 18 gage galvanized sheet steel.
- E. Inserts, bolts and fasteners: Manufacturer's standard units, except hot dip galvanize items to be built into exterior walls, complying with ASTM A153, Class C or D as applicable.
- F. Shop applied paint: For steel surfaces use baked enamel or paint, suitable as a base for specified finish paints.

2.02 FABRICATION

- A. General:
 - 1. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles.
 - 2. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at the site.
 - 3. Fabricate exposed faces of doors and panels from only cold-rolled steel.
 - 4. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).
 - 5. Fabricate exterior doors, panels and frames from galvanized steel. Top edge of doors in exterior walls shall be fitted with a flush water-tight closure.
- B. Exposed fasteners: Provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.
- C. Finish hardware preparation:
 - 1. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware suppliers. Comply with applicable requirements of ANSI A115.
 - 2. Reinforce hollow metal units to receive surface-applied hardware Drilling and tapping for surface-applied finish hardware may be done at this site.
 - 3. Locate finish hardware in accordance with "Recommended Locations for Builders hardware, published by the National Builders Hardware Association.
- D. Shop painting:
 - 1. Clean, treat and paint exposed surfaces of fabricated hollow metal units, including galvanized surfaces.
 - 2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before the application of the shop coat of paint.

2.03 STANDARD STEEL DOORS

- A. General: Provide metal doors of the types and styles indicated on the Drawings or schedules and complying with S.D.I. 100 for minimum materials and construction requirements, similar to those manufactured by Tex-Steel Corporation, Harlingen, TX 78550; electrolyte zinc coated. CECO Door products or approved equal.

2.04 STANDARD STEEL FRAMES

- A. General:
 - 1. Provide metal frames of the types and styles indicated on the Drawings or schedules and complying with S.D.I. 100 and NAAMM Standard HMA 861 for minimum materials and construction requirements, similar to those manufactured by Tex-Steel Corporation, Harlingen, TX 78550, CECO Door products or an approved equal.
 - 2. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, as shown on the Drawings. Provide standard stops for interior door frames, except as noted on drawings. Conceal all fastenings.

3. Fabricate frames of welded construction. Miter all corners. No exceptions; "Sticks" are not acceptable.
 4. Form all frames of electrolytic zinc-coated galvanized steel.
 5. Coating Type: Regular G60.
- B. Door silencers: Drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.
- C. Plaster guards: Provide 26 gage steel plaster guards or mortar boxes, welded to the frame, at back of all finish hardware cutouts where mortar or other materials might obstruct hardware operation.

2.05 NON-STANDARD DOORS AND FRAMES

- A. When doors and frames are required which are not available from the manufacturer as stock items, provide such items as custom items constructed in conformance with the requirements for Type III doors within the profiles and size limitations shown on the Drawings. Where required by the Drawings, provide doors with full thickness solid core of rigid rock wool cut out to fit between stiffeners and to fit hardware reinforcements. Install core to completely fill the interior of the door. Install similar core in frames in these openings.

2.06 SOUND RATED ASSEMBLIES:

- A. Where sound rated door assemblies are required on the Drawings, provide as follows:
1. Minimum STC rating: 47
 2. Doors shall be formed of 16 gauge steel face sheets jointed on the vertical edges with welding. Door tops and bottoms shall be reinforced and completely closed with die formed 16 gauge steel channels welded in place. Core shall be a non-combustible, non-coupling filler.
 3. Fabricate frames for 14 gauge steel with the corners mitered, welded and ground smooth. Provide strike, hinge, and other hardware reinforcement of not less than 4.8 (3/16") thick steel spot welded in place. Provide frames with one welded in-floor anchor in each jamb and a temporary steel spreader to prevent distortion in shipment.
 4. Perimeter seals shall be magnetic or compression type at manufacturer's option. The hinge side shall be constructed so as to avoid pinching and other distortion of the seal from actions of the door.
 5. Automatic door bottoms shall be manufacturer's standard for STC 47 rating and shall close the entire gap between the door and the floor. The seal shall be 50-60 durometer neoprene and the actuating mechanism shall compress or retract the seal properly when the outer face of the door is within 5 cm (2") of the strike jamb.

PART 3: EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install hollow metal units and accessories in accordance with manufacturer's data, and as specified herein.
- B. Placing frames:
1. Comply with the provisions of Standard 100 of the Steel Door Institute, unless otherwise indicated.
 2. Except for frames located at in place concrete or masonry openings, place frames prior to construction of 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.

3. In masonry construction, locate three wall anchors per jamb at hinge and strike levels. Building-in of anchors and grouting of frames will be performed under provisions of Division 4 of these Specifications.
 4. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices. If attached with screws, provide "Z" fillers at each screw location to prevent collapse or distortion of frame when screws are tightened.
 5. When installed in prepared openings in concrete or masonry construction, install sealant between frame and concrete or masonry in compliance with the requirements of Section 07951.
- C. Door Installation:
1. Fit doors accurately in their respective frames, within clearances specified in S.D.I. 100.
 2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.03 ADJUST AND CLEAN

- A. Final adjustments: Check and readjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise damaged.
- B. Prime coat touch-up: Immediately after erection, sand smooth all damaged areas of prime coat and apply touch-up of compatible air-drying primer.

END OF SECTION

SECTION 08210
WOOD DOORS

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Furnish and deliver to the job site all wood doors indicated on the Drawings, specified herein, or needed for a complete and proper installation.
- B. Related work described elsewhere:
 - 1. Installing wood doors: Section 06200
 - 2. Finish hardware Section 08710

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified herein as listed in Section 01085.
- B. Qualifications of manufacture: All wood doors shall bear the NWMA seal of approval. Fire doors shall also bear the UL label for the designated rating.

1.03 SUBMITTALS

- A. General: Comply with the provisions of Section 01300.
- B. Product data: Within 45 calendar days after award of Contract, submit:
 - 1. Complete materials list showing all items proposed to be furnished and delivered under this Section.
 - 2. Sufficient data to demonstrate that all such items meet or exceed the specified requirements.
 - 3. A copy of the guarantee proposed to be furnished.

1.04 GUARANTEE

Upon delivery of the doors of this Section to the job site, and as a condition of their acceptance, deliver to the Architect two copies of an agreement written on the door manufacturer's standard form, signed by the door manufacturer and the Contractor agreeing to replace or repair defective doors which have warped (bow, cup, or twist) or which show photographing of construction below in wood veneer faces, as defined in NWMA Standard Door Guarantees, except the NWMA provision for refunding the price received by the door manufacturer for any defective door shall not apply. The guarantee shall also include refinishing and reinstalling which may be required due to repair or replacement of defective doors. Guarantee shall be in effect for a period of five years following date of acceptance.

1.05 PRODUCT HANDLING

- A. Protection:
 - 1. Protect the materials of this Section during transit, storage, and handling to prevent deterioration, damage, and soiling.
 - 2. Package each door at the factory in a separate heavy paper-type carton. Mark each carton for location to correspond with opening number on the Drawings.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 WOOD DOORS

- A. General: Wood doors shall be of the sizes, types, and designs shown on the Drawings.
- B. Adhesives and bonds: Use only adhesives and bonds conforming to NWMA I.S.-I standards, type II, for interior wood doors. Adhesives shall be non-staining.
- C. Warp tolerances shall be in accordance with A.I.S.
- D. Flush doors
 - 1. Except as otherwise directed, flush doors and transoms shall conform to the requirements of AWI PC-7, particle board, 7 ply bonded core doors, or 5 ply system to meet or exceed that specified.
 - 2. Required louvers shall be hardwood slats not less than 6 mm (1/4") in thickness, finished to match the

- door.
 - 3. Glazed openings: Glaze the doors where called for on the Drawings, providing glass and glazing in accordance with the requirements specified in Section 08800.
 - 4. Face skins:
 - a) For doors called for to have natural finish, provide AWI custom grade **unselect** stain-grade **birch** faces with hardwood stiles on all vertical stiles.
 - b) For all other doors, provide sound grade **Birch** for opaque paint finish.
 - 5. Solid Color Door shall conform to the requirements of AWI Type APC.
- E. Vertical stiles, nonrated and 20 minute rated.
- 1. Matching hardwood outer stile edge, 9/16" minimum before trim.
 - 2. Overall stiles 1 3/8" minimum rated.
- F. Rail edges, nonrated and 20 minute rated.
- 1. Mill option, softwood or hardwood.
 - 2. 2" minimum after trim.
- G. Labeled Fire Door Core, 45 minute, 1 hour, 1 1/2 hour.
- 1. Noncombustible mineral.
 - 2. Containing no asbestos.
- H. Vertical stile, 45 minute, 1 hour, 1 1/2 hour rated doors.
- 1. Visually compatible with face veneer.
 - 2. Minimum 1 1/8" thick.
 - 3. Laminated for improved screw holding and split resistance.
 - 4. (Specify if matching edges are required).
- I. Rail edges, 45 minute, 1 hour, 1 1/2 hour.
- 1. Top rail 1 1/4" minimum.
 - 2. Bottom rail 1 1/2" minimum.
 - 3. Containing no asbestos.
- J. Ratings for fire doors as called for in door schedule.
- K. Plastic Laminated Doors: (**Where noted in door schedule**)
 MODEL: AWI TYPE PC-HPDL
 STYLE: FLUSH
 FACE: High pressure decorative laminates from door manufacturer's stand woodgrains, or solids, standard grade. (.050) plastic laminate manufactured by Pionite, Nevamar, or Wilsonart.
 CORE: Mat-formed particle board conforming to latest edition of CS 236, Type 1, Density C, Class 1.
 STILE EDGES: Hardwood 1" , minimum after trimming, stained or painted to match face laminate. (Specify to supply laminate edges if required).
 RAIL EDGES: Mill option softwood bonded to core, 1" minimum after trim.
- L. LABELED PLATIC LAMINATE DOORS: (**Where noted in door schedule**)
 MODEL: AWI Type FD 3/4, FD 1, FD 1-1/2.
 STYLE: Flush
 FACE: High pressure decorative laminates from door manufacturer's standard woodgrains or solids.
 CORE: Non-combustible material.
 STILE EDGES: 5/8" after trimming treated hardwood.
 RAIL EDGES: Top, 1/2" minimum treated.
 Bottom, 1 1/2", minimum treaded
 RATING: As indicated on drawings.
- K. All wood doors should have a Lifetime Warranty.

2.02 PRE-FITTING AND PREPARATION FOR HARDWOOD

- A. Pre-fit and pre-machine all wood doors at factory.
- B. Pre-machine doors in accordance with final approved hardware and frame schedule.

- C. Fire doors shall be machined in strict compliance to provision of NFPA-0 latest edition.
- D. Pre-machine doors within industry tolerance. "A plush or minus 1/32" will be allowed on all hardware locations. A plus 1/32" minus 0-inch tolerance will be allowed on hinge cutouts. A plush 1/64" minus 0-inch tolerance will be allowed on lock from preparation cutouts.

2.03 FABRICATION

- A. General
 - 1. Comply with AWI Quality Standards Section 1300 except to meet or exceed requirements herein specified.
 - 2. Completely factory pre-fit to required size ready to installation at project site, no on-jobsite trimming permitted.
 - 3. Prepare in accordance with frame shop drawings and schedule, hardware schedule and templates.
- B. Fabricating Tolerances
 - 1. Pre-fit size: Plus or minus 1/32" overall dimensions.
 - 2. Squareness: Length or diagonal measured on face of door from upper right corner to lower left corner between length or diagonal measured on upper left corner to lower right corner with maximum difference of 1/8"
 - 3. Maximum warp. 1/4"
 - 4. Show-through (telegraphing): 1/100" deviation from true plans

PART 3: EXECUTION

3.01 DELIVERY:

- A. Deliver the work of this Section to the jobsite in a timely manner to permit orderly progress of the total work.

3.02 INSTALLATION:

- A. Installation of the work of this Section is described in Section 06200.

END OF SECTION

SECTION 08413

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Kawneer Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.
 - 1. Types of Kawneer Aluminum Storefront Systems include:
 - a. Trifab® VG 451 Storefront System – 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension; Non-Thermal; Center, Structural Silicone or Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick or Punched Opening Fabrication.
- B. Related Sections:
 - 1. Division 072700 "Air Barriers" for materials used to bridge between aluminum storefront system and building intersection
 - 2. Division 079200 "Joint Sealants" for joint sealants installed as part of the aluminum sliding door system
 - 3. Division 084113 "Aluminum-Framed Entrances and Storefronts"
 - 4. Division 084313 "Aluminum-Framed Storefronts"
 - 5. Division 08710 Finish Hardware

1.3 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed storefront system shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Design Wind Loads: Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Structural Drawings S1.1.
- B. Storefront System Performance Requirements:
 - 1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of inward and outward as required for project region. The design pressures are based on the International Building Code; 2006 Edition.

2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft² (0.3 l/s • m²) at a static air pressure differential of 6.24 psf (300 Pa).
3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501
4. Uniform Load: A static air design load of 20 psf (958 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
5. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than:
 - a. Glass to Center – 0.44 (low-e)
6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
 - a. Glass to Center – 62_{frame} and 68_{glass} (low-e) or 63_{frame} and 56_{glass} (clear).
7. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested to AAMA Specification 1801 and in accordance with ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than:
 - a. Glass to Center – 37 (STC) and 30 (OITC)

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum frame storefront system indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum framed storefront system and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, of aluminum framed storefront.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (300 mm) lengths of full-size components and showing details of the following:
 1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Glazing.
 5. Flashing and drainage.
- G. Other Action Submittals:
 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware. See Section 08710 Finish Hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of providing aluminum framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum framed storefront system through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum framed storefront system and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for type(s) of storefront elevation(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- G. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- H. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of aluminum framed storefront openings by field measurements before fabrication

1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Kawneer Company Inc.
 - 2. Trifab® VG 451 (Non-Thermal) Storefront System
 - 3. 2" x 4-1/2" (50.8 mm x 114.3 mm) System Dimensions
 - 4. Glass: Center

- B. Substitutions: Refer to Substitutions Section for procedures and submission requirements
1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
 2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid storefront installation and construction delays.
 3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
 4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacture and fabrication of aluminum storefront for a period of not less than ten (10) years. (Company Name)
 5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
 6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 STOREFRONT FRAMING SYSTEM

- A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- D. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- E. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 08800 "Glass and Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. Color: Black
 - 2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - a. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

- A. Kawneer Aluminum Entrances.
 - 1. Series: 500 Tuffline® Entrances
 - 2. Finish/Color: (See 2.8 Finishes)
- B. Entrance Door Hardware: As specified in Division 08710 Section "Door Hardware."
 - 1. Weatherstripping:
 - a. Meeting stiles on pairs of doors shall be double weathered with one consisting of an adjustable astragal.
 - b. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be Kawneer sealer weathering. This is composed of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.

2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.7 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fit joints; make joints flush, hairline and weatherproof.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- C. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- D. Storefront Framing: Fabricate components for assembly using manufactures standard installation instructions.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. *Factory Finishing:*
1. *Kawneer Permanodic® AA-M12C22A31, AAMA 611, Architectural Class II Clear Anodic Coating, Color #17 Clear -Standard.*

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight framed aluminum storefront system installation.
1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum framed storefront system, accessories, and other components.
- B. Install aluminum framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

- D. Install aluminum framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within sliding door to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- F. Finish Hardware supplied under section 08710 shall be installed as part of section 08413 Aluminum Storefront and Entrances.

3.3 FIELD QUALITY CONTROL

- A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 - 1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
 - 2. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - 3. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.24 psf (300 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 08520
ALUMINUM WINDOWS

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Provide all aluminum windows, complete, in place, where shown on the drawings and as specified herein, and furnish all supplementary items necessary for the proper installation of the window system.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project manual shall apply to all work required for this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Caulking and-Sealants Section 07920
- B. Glass and Glazing Section 08800

1.03 SYSTEM DESCRIPTION

- A. Structural Requirements
 - 1. Design to withstand a positive and negative pressure wind-load acting inward and outward normal to the plane of the wall to meet the requirements of the ASCE 7-98 wind pressure for wind speed specified in structural drawings.
- B. Thermal Requirements: Make adequate provisions for expansion and contraction of the component parts of the system and its fastenings to prevent harmful damage caused by buckling, opening of joints, breakage of glass, undue stress on fastenings or other detrimental effects as will be caused by an ambient temperature range of 160 degrees F.

1.04 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this Section as listed in Section 01085.
- B. Qualification of manufacturer: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.
- C. Qualification of installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBMITTALS

- A. General: Comply with provisions of Section 01300.
- B. Manufacturers' data: within 45 calendar days after award of the Contract, submit:
 - 1. Complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
 - 3. Shop drawings showing all details of fabrication and installation include anchor size and spacing of window assembly to structure.
 - 4. Manufacturer's recommended installation procedures.

The manufacturer's recommended installation procedures, when approved by the Architect will become the basis for inspecting and accepting or rejecting actual installation procedures used on the work.

1.06 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS:

2.01 ALUMINUM WINDOWS, EXTERIOR APPLICATION:

- A. GENERAL: Furnish and install all season commercial window company series 860 SH and seires 700 HS, aluminum units, or an approved equal. Windows shall conform with all requirements of AAMA DH-A2-HP Specifications. Windows shall be furnished with necessary sub-frame system, including all clips, fasteners, mullion covers, etc., to provide a complete and weatherproof installation. **Units shall be equipped with sill latch to meet handicap requirements.** Manufacturer to ensure window unit is an acceptable assembly as outlined in the Texas Dept. of Insurance Product Evaluation Index (this index can be found on the web at WWW.TDI.STATE.TX.US/COMPANY/WIND/PROD/INDEX.HTML).
- A. Structural-Test Performance: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind load design pressures, assemblies do not evidence deflection exceeding L/180 of clear span.
 2. A minimum static air design load as per Structural Engineering Drawings shall be applied in the positive and negative direction.
 - a. When tested at 150% of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2% percent of clear span.
- B. Windborne-Debris-Impact-Resistance Performance: Shall be tested in accordance with ASTM E 1886 and information in ASTM E 1996.
1. Large –Missile Impact: For aluminum-framed systems located within 30 feet (9.1m) of grade.
 2. Small –Missile Impact: For aluminum-framed systems located within 30 feet (9.1m) above grade.
- B. Window frames and vent members shall be of commercial quality 6063-T5 extruded aluminum alloy. Frame members shall be not less than 2 7/16" in depth and .062" in wall thickness. Frame sill members shall be not less than .125" in thickness. Horizontal sash members and meeting rails shall be tubular sections. Vent perimeters shall be completely weatherstripped with woven pile and/or soft vinyl material. Each unit shall be equipped with White bronze positive cam lock and keeper. All joinery shall be adequately sealed to assure against weepage.
- C. Glazing: Units shall be designed to receive 1/4" thick gray tinted laminated glass. Glazing shall be supported to withstand ASCE 7-98 wind pressure for wind speed specified in structural drawings.
- D. Window units shall be field glazed with exterior aluminum snap-in glazing beads.
- E. Finish: Exposed surfaces of aluminum members shall be Anodized finish, clean and free from any surface blemish in:
1. ***Anodized Aluminum finish.***
- F. Shop Drawings: Provide complete shop drawings in full size details indicating all conditions of surrounding construction relating to installation.
- G. Erection: Erection shall be by others using only skilled mechanics with prior experience in installation of commercial type window systems.
- H. Units shall be plumb, level and true to plane following complete installation in accordance with detailed shop drawings.
- I. Materials for caulking and sealing window perimeter shall be of high quality content as specified in project requirements.
- J. Guarantee: All work under this specification shall be guaranteed against defects in material and workmanship for a period of one (1) year from the date of acceptance of the installation

END OF SECTION

SECTION 08800

GLASS AND GLAZING

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Provide all glass and glazing, complete, in place, as shown on the drawings, specified herein, or needed for a complete and proper installation.
- B. Related work described elsewhere:
 - 1. Glass and glazing are required under various Sections of these specifications.
 - 2. Toilet room mirrors are specified in Section 10830.
 - 3. Section 08810 Fire Rated Glass.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this Section and as listed in Section 01085.
- B. Qualifications of installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

- A. General: Comply with the provisions of Section 01300.
- B. Product data: Submit:
 - 1. Complete materials list showing all items proposed to be furnished and installed under this Section.
 - 2. Sufficient data to demonstrate that all such materials meet or exceed the specified requirements.

1.04 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 GLASS

- A. General: Glass is called for on the drawings.
- B. Where type of glass indicated on the drawings the following applies:
 - 1. ***Exterior Doors and Windows:***

LOW-E INSULATING GLASSType:

Low-E Tinted Insulating Glass. Neutral-Gray, low-reflective glass outdoor appearance.

Product: "Solarban®" z50 (2) + "Clear Glass" by PPG Industries, Inc.

Insulating Unit Construction: Tempered 1/4 inch (6mm) "Solarban®" z50 (2) Glass + 1/2 inch (13mm) air space + Tempered 1/4 inch (6mm) "Clear" Glass, "Solarban"z50 Solar Control (Sputtered) on second surface (2).

Performance Values: Visible Light Transmission - 51 percent; SHGC - 0.31;

Shading Coefficient - 0.36; Outdoor Visible Light Reflectance - 8 percent.

Heat Transfer Coefficient: U-Value Winter - 0.29, U-Value Summer - 0.27.

2. *Fire rated Interior Doors and Windows: 3/16" thick firelite NT by TGP or equal. Reference Section 08810 FIRE RATED GLASS for more information.*
3. *Non-fire rated interior doors and windows: 1/4" thick laminated, clear.*
4. *At all Hollow Metal Doors: 1/4" thick clear laminated glass.*

2.02 GLAZING COMPOUNDS AND SEALANTS

- A. General: Use glazing compounds and preformed glazing sealants approved for the application and, except as otherwise specified, conforming to the Glazing Materials portion of the FGMA Glazing Manual.
- B. Use of metal sash putty will not be permitted, but compound conforming to Fed. Spec. TT-G-410 will be permitted. The use of nonskinning compounds, nonresilient type preformed sealers, and preformed impregnated type gaskets will not be permitted.
- C. Other requirements:
 1. Use flexible vinyl gasket material where indicated on the drawings, conforming to CS 230.
 2. Use materials with aluminum frames that are aluminum colored, nonstaining, and that do not require painting.
 3. Use other materials, exposed to view and painted, color selected for custom color.

2.03 GLAZING ACCESSORIES

- A. Provide all glazing accessories required to supplement those accessories which accompany the items to be glazed, and as needed to provide a complete installation, including glazing points, clips, shims, angles, beads, settling blocks, and spacer strips. Use ferrous metal, which will be exposed in the finished work, which has a finish that will not corrode or stain while in service.

PART 3: EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which work of this Section will be installed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Selection of glass: Where plate glass is indicated or specified, float glass may be used.
- B. Distortion: Cut and install glass with the visible lines or waves running with the horizontal direction.
- C. Fix movable items securely, or in a closed and locked position, until glazing compound has thoroughly set.
- D. Glass setting:
 1. Items to be glazed shall be shop-glazed or field-glazed with glass of the quality and thickness specified.
 2. Prepare surrounds and glass, unless otherwise directed, in conformance with the details and general conditions governing glazing in the FGMA Glazing Manual.
 3. Aluminum windows and wood doors may be glazed in conformance with one of the glazing methods described in the standards under which they are produced.
 4. Use beads or stops furnished with the items to be glazed to secure the glass in place.
 5. Use insulating units which do not have corners or edges ground, nipped, cut, or fitted after leaving the factory. Do not subject units to springing, forcing, or twisting during setting. Handle so as not to strike the setting frames or other objects.

3.03 CLEANING

- A. In addition to the requirements of Section 01710 of these specifications, and prior to acceptance of the work, thoroughly clean all glass and remove all labels, paint spots, putty, and other defacements.

END OF SECTION

SECTION 09100
LATH AND PLASTER

PART 1 - GENERAL:

1.01 DESCRIPTION:

- A. **WORK INCLUDED:** Lath and plaster required for this Work consists of exterior stucco and interior plaster where shown on the Drawings, specified herein, or needed for a complete and proper installation and not specifically called for under other Sections of these Specifications.

1.02 QUALITY ASSURANCE:

- A. **STANDARDS:** Comply with standards specified herein as listed in Section 01085.
- B. **QUALIFICATIONS OF PERSONNEL:** Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. **CODES:** In addition to complying with all pertinent codes and regulations, comply with the materials handling and workmanship provisions of "Reference Specifications" of the California Lathing and Plastering Contractors Association.

1.03 SUBMITTALS:

- A. **GENERAL:** Comply with provisions of Section 01300.
- B. **PRODUCT DATA:** Within 45 calendar days after award of the Contract, submit:
1. Complete materials list of all items proposed to be furnished and installed under this Section.
 2. Sufficient data to demonstrate compliance with the specified requirements.
 3. Samples of the proposed accessories.

1.04 PRODUCT HANDLING:

- A. **PROTECTION:** Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. **REPLACEMENTS:** In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2: PRODUCTS

2.01 METAL MEMBERS:

- A. **STEEL CHANNELS:**
1. Steel channels shall conform to ASTM A109 or ASTM A303.
 2. Hot-rolled or cold-rolled channels for framing and furring be galvanized.
 3. Cold-rolled channels shall have flanges not less than 11 mm (7/16") wide.
- B. **METAL PLASTERING ACCESSORIES:** All screeds and other metal accessories shall be standard shapes for their intended use and shall be fabricated from 26 gauge or heavier hot-dipped zinc galvanized steel, prime-coated unless otherwise specifically approved by the Architect, and coated with a protective material to permit removal of overspray at completion of plastering.
- C. **HANGERS** supporting runner channels shall be soft, annealed steel wire not less than 4.12 mm (0.1620") nominal diameter, 8 gauge, conforming to Fed. Spec. QQ-W-461, steel number 1010, 1008, or 1006, Class 1 zinc coating. Flat iron or steel straps, at least 2.4 mm x 22.2 mm (3/32" x 7/8") size coated with zinc, cadmium, or rust-inhibiting paint, may be substituted for the wire hangers.

- D. MISCELLANEOUS FASTENERS shall be as selected by the Contractor, subject to the approval of the Architect.
- E. METAL LATH shall:
 - 1. Be paper backed metal lath welded or woven in such a manner as to provide not less than 6 mm (1/4") keying between wire and paper backing, or keying shall be obtained by a uniform series of slots in a paper separator woven between the two layers of wire.
 - 2. Self furring as indicated on drawings all metal lath shall be subject to the approval of the Architect. Lath shall be galvanized.

2.02 PLASTER: - GENERAL:

Furnish and install integral color exterior stucco finish to use over Portland Cement-lime base coats only, in a standard color, as selected by the Architect from samples prepared at job site.

- A. CEMENT for plaster shall be Portland Cement conforming to ASTM C150, Type 1. No plastic cement will be permitted unless specifically approved in advance by the Architect.
- B. LIME used for plaster shall be dry hydrated lime conforming to ASTM C206, lime putty, if used, shall weight no more than 131 kg per cu. m (83 lbs. per cu. ft.).
- C. SAND used for plaster shall be clean and well graded from coarse to fine, and shall conform to ASTM C144.
- D. WATER used for plaster shall be clean and free from deleterious amounts of acid, alkali, and organic materials.

2.03 OTHER MATERIALS:

All other materials, not specifically described but required for a complete and proper installation of the Work of this section, shall be as selected by the Contractor subject to approval of the Architect.

2.04 ACCESSORIES:

Furnish and install, at all appropriate locations, the following items:

- A. STANDARD CORNER BEAD 26 gauge or heavier, galvanized expanded metal wings 2½" or more wide, with solid nosing, at all exterior corners of interior plaster construction, such as USG 1-A or INRYCO-MILCOR No. 1.
- B. CASING BEAD, 3/4" typical, galvanized metal, for interior and exterior applications, such as USG #66 square edge with expanded flange.
- C. CORNERITE, for interior applications, at internal plaster angles.
- D. CONTROL JOINT, made from roll-formed zinc alloy, for interior and exterior application, such as USG #75, for 3/4" applications.
- E. FOUNDATION SILL SCREED, standard pattern #7, 26 gauge or heavier steel, perforated along lower edge to permit escape of trapped water.
- F. EXPANSION JOINT, standard pattern #15 (INRYCO-MILCOR) used to divide exterior Portland Cement plaster.
- G. DRIP SCREED, made of aluminum, similar to FRY REGLET CORP. in 3/4" size, used at head of windows and as shown on the Drawings.

PART 3: EXECUTION

3.01 INSPECTION:

- A. Examine the areas and conditions under which Work of this section will be performed. Correct conditions detrimental to the timely and proper completion of the Work. Do not proceed until satisfactory conditions are corrected.

3.02 INSTALLATION OF FRAMING:

- A. COORDINATION: Carefully coordinate with all other trades. Ensure full and ample provision in the work of other trades to accept the work of this Section. Provide embedded wire supports as necessary.
- B. INSTALLATION: Install the metal members anchoring all components firmly into position. Use nominal 3/4" CRC supported by suspended 1½" CRC.

3.03 LATHING:

Install the approved paper back lath in strict accordance with the manufacturer's recommendations as approved by the Architect.

3.04 PLASTERING:

- A. GENERAL: Perform all mixing, plastering, and plaster curing in strict accordance with the provisions of the reference standards.
- B. SCRATCH COAT: Apply the scratch coat with sufficient material and force to form good keys, embedding and filling all spaces of the netting. Score to receive brown coat.
- C. BROWN COAT:
1. Do not apply the brown coat sooner than forty-eight (48) hours after installation of the scratch coat.
 2. Apply the brown coat to the scratch coat. Bring out to ground straighten to a true surface, and leave sufficiently rough to ensure adequate bond of the finish coat.
- D. FINISH COAT:
1. Do not apply the finish coat sooner than seven {7} days after installation of the brown coat.
 2. Apply a smooth finish coat.
- E. TOLERANCES: Finish all plaster true and even with a tolerance of one in 500, leaving the finished surface free from tool marks and all other blemished.
- F. CLEANING METAL ACCESSORIES: Wipe all metal accessories clean after application of each coat.

3.05 CLEANING AND PROTECTION:

- A. GENERAL: In addition to all other protection, protect all adjacent finished surfaces from the accidental application of plaster.
- B. CLEANING UP: In addition to the requirements of Section 01710, upon completion of the work of this Section promptly inspect all adjacent surfaces and remove all traces of spilled and splashed plaster.

END OF SECTION

SECTION 09260
GYPSUM DRYWALL

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Gypsum Drywall indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual shall apply to all work required for this section.
- C. Applicable requirements of the following sections of this Project Manual apply to all work required for this section.
- D. Installation of the tape and bedding of gypsum drywall is specified in the Painting Section and is not required in the work for this section.

1.02 DELIVERY AND STORAGE

- A. Deliver materials to the job site in their original unopened packages, containers, and bundles bearing the manufacturer's name and brand name.
- B. Store material in an enclosed space protected from damage and exposure to the elements. Remove damaged material from the premises.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents

- 1. DRYWALL SYSTEMS:
 - The Celotex Corporation The Flintkote Company
 - Georgia-Pacific Corporation Kaiser Gypsum
 - National Gypsum Company
 - Owens-Corning (Sound Insulation)
 - United States Gypsum Company

2.02 MATERIALS

- A. NONRATED GYPSUM WALLBOARD: ASTM C36, tapered edge, 5/8 inch thick, unless otherwise indicated.
- B. FIRE-RATED GYPSUM WALLBOARD: ASTM C36, Type "X", UL labeled, tapered edge, 5/8 inch thick, unless otherwise indicated.
- C. MOISTURE RESISTANT: 5/8" Gypsum wall board equal to USG, WR with fire core.

PART 3: EXECUTION

3.01 PREPARATION

- A. Examine spaces and correct defects that could interfere with proper installation. Starting work shall be construed as acceptance of spaces.
- B. Maintain in cold weather uniform controlled range temperature between 55 deg. to 70 deg. F. during the installation. Provide adequate ventilation to eliminate excessive moisture.

- C. Install gypsum drywall systems in accordance with the Gypsum Drywall Contractors International Underwriters Laboratory and the manufacturer of the Drywall material.

3.02 INSTALLATION

A. Metal Stud Framing

1. Align partitions accurately according to partition layout. Align top and bottom tracks and secure to concrete slab with concrete stub nails or power driven anchors spaced 24" on centers.
2. Position studs in track by rotating into place for friction fit. Space studs at 16 inches on center, unless otherwise indicated. Locate studs no more than 16" from partition intersections and corners and secure with screws through both flanges of studs and tracks. Lap studs a minimum of 8" where splicing is necessary and secure with screws.
3. Place two metal studs back-to-back on each side of door and window frames. Fasten studs securely to anchors on each side of frame with bolts or screws. Locate third stud six inches from double studs.
4. Locate section of runner across frame head at doors and other openings and screw slit flanges to vertical studs. Erect short intermediate studs 16" on centers between ceiling runner and door frame head runner.
5. Stud Framing:
 - a. For interior partitions use metal studs, 22 ga., screw type, width as required for partition width indicated maximum stud spacing to be 24" o. c.
 - b. For exterior wall application, use galvanized steel studs, 6" wide, with maximum spacing of 16" o c., 18 ga. studs for walls over 12' high and 20 ga. for walls under 12' high.

B. Wallboard:

1. Install wallboard to walls with long edge parallel to supporting members using full length sheets. Stagger joints on opposite sides of partition. Provide support for all edges and screw wallboard to bottom runners. Apply sealant to perimeter of wallboard at floor and ceiling.
2. Butt joints loosely, maximum gap 1/4". Sand edges that have been cut. Attach wallboard to metal supports with self-drilling screws, using an electric screw driving gun and Phillips bit. Drive screws to slightly dimple surface but not to break paper.
3. Space screws 16" on centers in the field and 8" on centers staggered along the vertical abutting edges. Start field screwing near center and work towards edges. Space screws not less than 3/8" from wallboard edges. Space screws for fire rated partitions as required by U.L.
4. Attach wallboard on one side of partition by screwing to every other stud. Complete wallboard application to entire side of partition in this manner. Cut first panel 2 foot wide on opposite side so joints will be staggered. Fasten wallboard panels to all studs on this side of panel. Return to first side and complete attaching screws to previously unattached studs.
5. Install insulation to inside face of first side of partition with staples or mastic. Anchor batt in each corner and in center. Fit joints snugly against adjoining batts and framing members.
6. Apply face layer in laminated construction vertical with adhesive per manufacturer's recommendations. Hold in place with supplemental fastening until adhesive is dry. Offset face layer joints so they do not fall over backing board joints.
7. Fit wallboard snugly into steel door frames. Cut wallboard neatly to fit around all outlets and switch boxes. Install metal edge trim along top edge of all wallboard at ceiling and wherever wallboard edge is exposed, or abuts another material. Install corner bead at all exterior corners.

3.03 CLEANING AND PATCHING:

- A. Clean exposed surfaces of wallboard free from soil and stain that would affect finish. Repair, or remove and replace defective work. Remove excess materials and debris from site.

END OF SECTION

SECTION 09310
CERAMIC TILE - GENERAL

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Ceramic Tile indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual apply to all work required for this Section.
- C. The various types of ceramic tiles are specified in their respective section
- D. The various types of installation materials and methods are specified in their respective sections.

1.02 SUBMITTALS

- A. Samples
 - 1. Submit samples for each color, pattern and type of wall tile to be used.
 - 2. Submit samples for each type, color and pattern of floor tile used.
- B. Certification.
 - 1. Identification: The Certification mark of the Tile Council of America shall appear on each label or carton of tile.
 - 2. Grade and Certificate: All tile shall be Standard Grade and containers grade-sealed in accordance with minimum-grade specifications established in TCA 137.1 In addition to grade seal, furnish Architect with master grade certificate stating grade, kind of tile, identification marks for tile packages, name and location of job signed by the manufacturer and the tile contractor.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. Ceramic Tile:
 - a. United States Ceramic Tile Company
 - b. Lone Star Ceramics Company
 - c. American Olean Tile Company
 - d. Monarch Tile Company
 - e. Winburn Tile Company
 - f. Dal-Tile Corporation
 - 2. Mortar and Grout:
 - a. The Upco Company
 - b. L & M Products, Inc.
 - c. Laticrete International, Inc.
 - 3. ***Grout Colors: Unless noted otherwise or changed during color selection***
 - a. Interior walls – Colors to be determined during submittals.
 - b. Floor: Colors to be determined during submittals.

2.02 MATERIALS

(As specified in their respective sections.)

PART 3: EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive tile and do not start work until defects that will adversely affect tile work have been corrected.
- B. Inspect all surfaces to see that they are dry, clean, free of oily or waxy film, firm, level and plumb. Report any unsatisfactory conditions to the Architect. Starting installation shall be deemed as acceptance of surfaces.
- C. Do not start until work of other trades, which goes through or in the space behind tile has been completed. Do not proceed with installation until adjoining work is satisfactorily protected. Close off spaces in which tile is being set to traffic and other work during installation and for at least 48 hours after completion of tile work.
- D. Do not apply mortar and adhesives to surfaces covered by frost. Maintain minimum temperature-for installation of tile above 50 Deg. F. Prevent rapid evaporation of moisture from mortar bed. Do not set tile on dry bed.

3.02 WORKMANSHIP

- A. All tile and workmanship shall be in accordance with the TCA and in a manner conforming with the best current practice of the industry.
- B. Center fields and patterns on applied areas so that no tile is less than half size. For heights stated in feet and inches, maintain full courses to nearest attainable height without cutting tile.
- C. Except where otherwise shown or specified, make joints in wall tile vertical and horizontal and joints in floor tile perpendicular and parallel to walls. Control joint widths of glazed tile by lugs on the sides of tile. Control joint widths between sheets of ceramic mosaic tile by supporting boards with metal spacing strips.
- D. Grind and fit tile carefully at intersections, against trim finish and at built-in fixtures and accessories. Fit tile closely around outlets, pipes, fixtures and fittings so that plates, escutcheons and collars will overlap cuts. Cut and drill tile and trim shapes accurately without damage. Rub all exposed cut edges smooth with abrasive stone.
- E. Coat trim with 1/32 to 1/16" pure coat paste. Set in same mortar mix as is recommended for setting flat tile on walls. Do not use pure coat as mortar to set trim and angles.

3.03 INSTALLATION

- A. As specified in their respective sections according to installation method indicated. Use thin-set method of installation with appropriate mortar and materials as recommended by manufacturer.

3.04 CLEANING

- A. Sponge and wash tile thoroughly with clear water after the grout has stiffened. Then clean by rubbing with damp cloths or sponges, and polish with clean dry cloth.

END OF SECTION

SECTION 09312
GLAZED CERAMIC WALL TILE

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for the proper installation of all Glazed Ceramic Wall Tile.
- B. The requirements of Division 0 - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual apply to all work required for this Section.
- C. The requirements of Section 09310 - Ceramic Tile of this Project Manual shall apply to all Work for this Section.
- D. Mortars, adhesives and grouts required for the installation of this tile are specified in their respective sections.

1.02 SUBMITTALS

- A. As specified in Section 09310 - Ceramic Tile.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As specified in Section 09310— Ceramic Tile.

2.02 MATERIALS

- A. GLAZED CERAMIC WALL TILE: TCA 137.1, machine made, colors as selected, cushion edges, non-vitreous body colored, matte finish, size 4¼"x4¼" Dal-Tile, or approved equal, ***refer to construction documents for patterns and group*** colors.
- B. GLAZED CERAMIC WALL TILE TRIM SHAPES: As required of same type, size, thickness, material and color as wall tile; TCA 137.7. All outside corners: Flat bullnose, All Bases: Coved.

PART 3: EXECUTION

3.01 INSTALLATION:

- A. Where metal door frames abut ceramic tile outset frames 3/8" to allow tile to end against the frame return thereby eliminating bullnose tile at this location. Unless otherwise indicated on the Drawings, at top of wainscot no bullnose. Strike grout 45° back to wall.
- B. General installation requirements are specified in SECTION-09310/CERAMIC TILE. Use thin-set method of installation with appropriate mortar and materials as recommended by manufacturer.
- C. Particular installation requirements for various setting and grouting methods are specified in their respective sections.

END OF SECTION

SECTION 09316
CERAMIC MOSAIC TILE

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for the proper installation of all Ceramic Mosaic Tile.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual apply to all work required for this Section.
- C. The requirements of Section 09310 - Ceramic Tile of this Project Manual shall apply to all work for this Section.
- D. Mortars, adhesives and grouts required for the installation of this tile are specified in their respective sections.

1.02 SUBMITTALS

- A. As specified in Section 09310 - Ceramic Tile.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As specified in Section 09310 - Ceramic Tile

2.02 MATERIALS

- A. CERAMIC MOSAIC FLOOR TILE: TCA 137.1, domestic, machine made, unglazed, colors and patterns (**refer to construction documents**), vitreous body, natural clay type, 1/4" thick, cushion edges, size 2"x 2".
- B. CERAMIC MOSAIC TILE TRIM SHAPES: None

PART 3: EXECUTION

3.01 INSTALLATION

- A. Thinset.
- B. Particular installation requirements for various setting and grouting methods are specified in their respective sections.
- C. Expansion Joints: 1/4" wide (nominal)
 - 1. Directly above all floor slab construction joints.

END OF SECTION

SECTION 09501
ACOUSTICAL CEILINGS
STEEL EXPOSED SUSPENSION SYSTEM

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Acoustical Ceilings Steel & Alum. Exposed Suspension System indicated by the Contract Documents and furnish all supplementary items for the proper installation.
- B. The requirements of Division 0 - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual apply to all work required for this Section.

1.02 SUBMITTALS:

- A. Samples: Submit 12"x12" samples of suspension system showing cross tee connection to main beam. Submit 12" long sample of angle molding.
- B. Shop Drawings: Show erection details and location of all openings in system.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable provided it complies with the Contract Documents:
 - 1. SUSPENSION SYSTEMS:
 - a. ARMSTRONG
 - b. CHICAGO METALLIC
 - c. DONN, PRODUCTS, INC.
 - d. EASTERN PRODUCTS CORPORATION
 - e. NATIONAL ROLLING MILLS

2.02 MATERIALS

- A. STEEL EXPOSED SUSPENSION GRID SYSTEM: CHICAGO METALLIC FIRE FRONT 250 SYSTEM, chemically cleansed, electrogalvanized and bonderized, with high-baked enamel finish on all parts and painted white enamel finish on exposed surfaces, ASTM C-635, maximum deflection 0.133 inch, Intermediate Duty.
 - 1. Main Beams: .017 inch minimum commercial grade steel, bulb section, 1-1/2" web and 15/16" flange, 12 lbs. per lineal foot simple span minimum load limit. Rout beams at 12" on center.
 - 2. Cross Tees: .017 inch minimum steel, 1 1/4" web and 15/16" flange, forced TAB-LOCK ends for attachment to adjoining beam cross tee, providing minimum torsional movement and lateral displacement. Rout tees at 12" on center.
 - 3. Beam Cross Tees: .017 inch minimum steel, 1 1/2" web and 15/16" flange formed TAB-LOCK ends for attachment to adjoining main beam, providing minimum torsional movement and lateral displacement, 12 lbs. per lineal foot simple span minimum load limit. Rout tees at 12".
 - 4. Angle Molding: .020 inch minimum cold rolled steel, 15/16"x15/16".
 - 5. Accessories: Specifically designed as an integral part of the grid system.
 - 6. Fire rates when fire rated ceiling tile is required.
- B. STEEL EXPOSED SUSPENDED GRID SYSTEM AT ALL NON-FIRE RATED CONSTRUCTION, (CHICAGO METALLIC 200 SNAP-GRID) Chemically cleansed, electrogalvanized and bonderized, with high-baked enamel finish on all parts and painted white enamel finish on exposed surfaces, ASTM C-635, maximum deflection 0.133 inch, intermediate Duty.
- C. WIRE: 12 gauge galvanized, soft annealed, mild steel wire.

PART:3: EXECUTION

3.01 PREPARATION

- A. Examine spaces and correct defects that could interfere with proper installation. Installed suspension system shall meet requirements of "Specifications for Acoustical Tile and Lay-in Panel Ceiling Suspension System," published by the Acoustical Materials Association.
- B. Install acoustical treatment after moist materials have been installed. Maintain temperature and humidity conditions closely approximating the interior conditions which will exist when the building is occupied but not less than 50 Deg. or more than 85 Deg. F. before, during and after installation.
- C. Layout spaces and arrange suspension system in a regular pattern parallel or perpendicular to surrounding walls. Arrange system symmetrically about room centerlines in both directions equalizing borders. No border shall be less than one-half the tile width.

3.02 STEEL EXPOSED SUSPENSION SYSTEM INSTALLATION

- A. Install angle molding around perimeters and abutting surfaces, at proper level for finished ceiling height. Miter angle molding at exterior corners; cut flanges and bend web to form interior corners.
- B. Suspend main beams spaced 4'-0" on center from structure with wire hangers spaced 4'-0" on center (5'-0" o.c. where supported by purlins) Install main beams level within 1/8 inch in 12 feet with hanger wire taut and tightly wrapped to prevent vertical movement or rotation. Do not make local kinks or bends in hanger wires as a means of leveling. Join beams with approved splice unit. Install at 2'-0" o.c. where 24"x24" tile is used.
- C. Install beam cross tees at right angles to main beams, space at 2'-0" on center and join to main beams with positive interlock. Install beam cross tees to within 1/32 inch of their required location and within 0.015 inch of the same horizontal plane as main beam, and never below continuous member.
- D. Lay ends of main beams and cross tees on angle mouldings at vertical surfaces. Provide additional hanger wires at each corner of recessed light troffers and other concentrated load conditions to prevent deflection in excess of 1/240th of the span.
- E. Install cross tees at right angles to beam cross tees to support ends of light fixtures, diffusers or grilles.

3.03 CLEANING AND PROTECTION

- A. Protect acoustical materials and treatment from damage before, during and after installation. Clean to remove soil and stain. Remove and replace damaged units and units which cannot be cleaned. Remove excess materials and debris from Site

END OF SECTION

SECTION 09660
RESILIENT FLOORING

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Provide all resilient flooring, complete in place, as indicated on the drawings, specified herein, or otherwise needed for a complete and proper installation of the work of this Section. Where indicated, match existing type and color.
- B. Related work described elsewhere:
CARPETING: SECTION 09680

1.02 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 the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

- A. General: Comply with pertinent provisions of Section 01300.
- B. Manufacturers' data:- Within 45 calendar days after award of Contract, submit:
 - 1. Complete materials list of all items proposed to be furnished and installed under this Section.
 - 2. Manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.
 - 3. Samples of each item, color, and pattern available in the specified products from the proposed manufacturer.
 - 4. Manufacturers' recommended methods of installation. {The manufacturers' recommended methods of installation, when approved by the Architect, will become the basis for inspecting and accepting or rejecting actual installation methods used on the work.}

1.04 PRODUCT HANDLING

- A. Delivery and storage: Deliver materials to the job site and store in their original unopened containers with all labels intact and legible at time of use; store in strict accordance with the manufacturers' recommendations.
- B. Protection: Use all means necessary to protect materials of this Section before, during, and after installation and to protect installed work and materials of all other trades.
- C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.
- D. Additional tile: Furnish to the Owner one carton of each pattern or color of replacement vinyl composition tile, rubber sports tile, and rubber (raised) tile.

PART 2: PRODUCTS

2.01 MATERIALS - GENERAL

- A. COLORS AND PATTERNS shall be as selected by the Architect from colors and patterns available from the approved manufacturer in the specified types. Approved manufacturers include Armstrong Cork Co., Azrock, Manington Tarkett Gafstar *Thru-Chip Tile* or approved equal, in 1/8" thickness *Refer to construction documents for patterns and colors.*
- B. ADHESIVES shall be a waterproof and stabilized type as recommended by the manufacturer of the approved resilient material. Asphalt emulsions and other non-waterproof types will not be acceptable. Adhesives shall not contain asbestos.

- C. CONCRETE SLAB PRIMER shall be a non-staining type as recommended by the manufacturer of the resilient material to be applied over it at all transition from V.C.T. to another flooring..
- D. EDGING STRIPS shall be 3 mm (1/8") thick, homogeneous vinyl or rubber composition, tapered or bullnose type, as approved by the Architect.
- E. VINYL COMPOSITION TILE, Item (F.1) on schedule, shall be 30 cm x 30 cm (12"x12") square 3.175 mm (1/8") thick "Thru-Chip", {or an equal approved in advance by the Architect, in colors selected by the Architect from standard colors of the approved manufacturer. }

2.02 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation of the work of this Section, shall be as recommended by the manufacturer of the resilient materials used, and as approved by the Architect.

PART 3: EXECUTION

3.01 INSPECTION

- A. General: Examine the areas and conditions under which resilient flooring is to be placed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Surface shall be smooth, level, at the required finish elevation, without more than 3 mm (1/8") in 3 m (10'-0") variation from level or slopes shown.

3.02 PREPARATION

- A. Subfloors: Prior to start of laying tile units, broom clean or vacuum all surfaces to be covered and inspect the subfloors. Start of laying tile will indicate acceptance of subfloor conditions.
- B. Concrete primer: Apply concrete slab primer if recommended by tile manufacturer, prior to application of the adhesive. Apply in compliance with manufacturer's directions.

3.03 INSTALLATION:

- A. General:
 1. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by tile manufacturer.
 2. Place tile units with adhesive cement in strict compliance with the manufacturer's recommendations. BUTT TILE UNITS TIGHTLY TO VERTICAL SURFACES, thresholds, nosings and edgings. Scribe as necessary around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines.
 3. Extend tile units into toe spaces, door reveals, and in closets and similar openings.
 4. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking device.
 5. Lay tile from center marks established with principal walls, discounting minor off-sets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 7.5 cm (3~) at room perimeters. Lay tiles square to room axis.
- B. Matching:
 1. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped or deformed tile are not acceptable.
 2. Tightly cement tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections
 3. Unless otherwise noted, lay tile in checkerboard pattern with grain in tile running in alternate

direction.

- C. Edgestrips: Place the resilient edgestrips tightly butted to tile, and secure with adhesive. Provide edgestrips at all unprotected edges of tile and at floor material transitions, unless otherwise shown.

3.04 CLEANING AND PROTECTION

- A. Move excess adhesive or other surface blemishes from tile, using neutral type cleaners recommended by the tile manufacturer. Protect installed flooring from damage until acceptance by the Owner.

3.05 FINISHING

- A. After completion of the work and just prior to final inspection, thoroughly clean tile floors and accessories. Apply wax and buff, with the type of wax, number of coats, and buffing procedures recommended by the tile manufacturer.

END OF SECTION

SECTION 09662
RESILIENT BASE

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Resilient Base and Resilient Stair Treads indicated by the Contract Documents and furnish all supplementary items necessary for the proper installation.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual shall apply to all work required for this Section.

1.02 SUBMISSIONS

- A. Samples:
 - 1. Submit 6" length of material of each color selected.

1.03 DELIVERY AND STORAGE

- A. Delivery material to the job site in manufacturer's original unopened containers with manufacturer's label on all containers.
- B. Store materials in original containers at not less than 70 Deg. F. for at least 24 hours before installation.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. RESILIENT BASE:
 - Armstrong
 - Azrock
 - Burke Flooring Products Company
 - Flexco Div. of Textile Rubber Co., Inc.
 - GAF
 - Johnson Rubber Co.
 - Mannington Mills
 - Mercer Plastics Co.
 - R.C. Musson Rubber Co.
 - Roppe Rubber Corporation
 - Vinyl Plastics, Inc. (VPI)

2.02 MATERIALS

- A. RESILIENT BASE: Rubber, 4" high continuous 120' roll, top set cove base at carpet floor, colors{s} as selected.
- B. ADHESIVES: As recommended by the base manufacturer. Use waterproof adhesive.
- C. RESILIENT STAIR TREADS consisting of single-piece units for width of stair treads, or equal-length units if tread width exceeds available manufacturer's lengths; "RAISED DESIGN STAIR TREADS" by ROPPE Corporation, Standard Profile Raised Circular Design, square nose, Type No. 90, or approved equal.

PART 3: EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive materials before work is started. Correct defects which could interfere with laying resilient materials in proper manner. Surfaces shall meet minimum requirements of the manufacturer of the

floor materials.

- B. Substrate shall be dry, broom clean, free of grease, curing compounds, mortar or any matter that will impair adhesion. Maintain range of 70 Deg. F. to 90 Deg. F. for materials and subfloor for at least 24 hours prior to installation.
- C. Starting work shall be construed as acceptance of conditions under which work will be done.

3.02 BASE AND TREAD INSTALLATION

- A. Do not apply base until backing material has dried out completely. Cement base to wall and built-in cabinet work using adhesive and method recommended by manufacturer.
- B. Install base tight to wall and floor in straight line. Install premolded internal and external corners neatly and accurately. Scribe base accurately to door frames.
- C. Base shall be-installed continuous, without seams, joints or splices for all runs less than 120 feet.
- D. Clean off surplus adhesive in accordance with manufacturer's installation directions using an approved cleaner, as the work progresses.

3.03 CLEANING AND PROTECTION

- A. Maintain minimum temperature of 70 Deg. F. at finish floor until building is accepted by Owner.
- B. Protect all resilient flooring which will be subjected to traffic, or which may be damaged due to subsequent construction operations, with heavy, nonstaining Kraft paper or other approved means.
- C. After all construction operations are completed, all resilient flooring shall be machine buffed for final acceptance.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Surface preparation.
- B. Surfaces finish schedule.

1.02 RELATED WORK

- A. Refer to Room Finish Schedule and interior wall elevations and exterior elevations.

1.03 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with three (3) years experience.
- B. Applicator: Company specializing in commercial painting and finishing with five (5) years documented experience.

1.04 SUBMITTALS

- A. Submit product data under provisions of Section 01300.
- B. Submit samples under provisions of Section 01300.
- C. Submit manufacture application instructions under provisions of Section 01300.

1.05 FIELD SAMPLES

- A. Provide samples under provisions of Sections 01300.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01600.
- B. Store and protect products under provisions of Section 01600.
- C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
- D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- E. Store paint materials at minimum, ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative is about 50 percent, unless otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interior; 50 degrees F for exteriors; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperatures for Varnish and Finishes: 65 degrees F for interiors or exteriors; unless required otherwise by manufacturer's instructions.

1.08 EXTRA STOCK

- A. Provide one gallon container of each color and coating to Owner.

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Section 09900 Painting

- B. Label each container with color, texture, and room locations in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS-PAINT

- A. Devoe Product: Architectural Grade.
- B. PPG Product: Architectural Grade.
- C. Sherwin Williams Product: Architectural Grade.
- D. Substitutions Under provisions of Section 01600.

2.02 ACCEPTABLE MANUFACTURERS-VARNISH AND URETHANE

- A. Devoe Product: Architectural Grade.
- B. PPG Product: Architectural Grade.
- C. Sherwin Williams Product: Architectural Grade.
- D. Substitutions Under provisions of Section 01600.

2.03 ACCEPTABLE MANUFACTURERS-STAIN

- A. Devoe Product: Architectural Grade.
- B. PPG Product: Architectural Grade.
- C. Sherwin Williams Product: Architectural Grade.
- D. Substitutions Under provisions of Section 01600.

2.04 ACCEPTABLE MANUFACTURERS-PRIMER-SEALERS

- A. Devoe Product: Architectural Grade.
- B. PPG Product: Architectural Grade.
- B. Sherwin Williams Product: Architectural Grade.
- C. Substitutions Under provisions of Section 01600.

2.05 ACCEPTABLE MANUFACTURERS-TRAFFIC MARKING PAINT

- A. Devoe Product: Architectural Grade.
- B. PPG Product: Architectural Grade.
- C. Sherwin Williams Product: Architectural Grade.
- D. Substitutions Under provisions of Section 01600.

2.06 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigment to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Accessory Materials: Paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.07 FINISHES

- A. Refer to schedule at end of Section for surface finish schedule.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces schedule to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Beginning of installation means acceptance of existing surfaces.

Section 09900-2

Section 09900 Painting

3.02 PREPARATION

- A. Correct minor defects and clean surfaces which affect work of this Section.
- B. Gypsum Board Surfaces: Repair minor defects. Spot prime defects after repair.
- C. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- D. Interior Wood Items to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- E. Metal Doors Schedule for Painting: Seal top and bottom edges with primer.

3.03 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.04 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry before next coat is applied.
- G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surfaces.
- H. Prime back surfaces of interior and exterior woodwork with primer paint.
- I. Prime back surfaces of interior woodwork scheduled to receive stain or varnish. Finish with gloss varnish reduced 25 percent with mineral spirits.

3.05 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Prime and paint exterior exposed pipes, conduit, boxes, brackets, collar and supports.
- B. Paint interior surfaces of air ducts, and convactor and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, limit of sight line. Paint dampers exposed behind louvers, grilles, and convactor and baseboard cabinets match face panels.
- C. Paint exposed conduit and electrical equipment occurring in finished areas.
- D. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

3.06 CLEANING

- A. As work proceeds, promptly remove paint where spilled, splashed, or splattered.
- B. During progress of work, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.07 SCHEDULE-EXTERIOR SURFACES

Note: Number of coats required for each product may vary from that which is indicated in order to achieve manufacturer recommended minimum dry film thickness.

- A. Pavement Markings and Fire Lane Curbs.
 - 1. One coat; stripes- yellow; fire lane curbs- red.
Sherwin Williams- ProMar Traffic Marking Paint B29.
 - 2. Minimum total dry film thickness 6.0 mil.

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- B. Steel- Shop Primed
 - 1. Touch-up with red oxide primer.
 - 2. Two coats alkyd enamel, gloss.
Sherwin Williams- Silicone Alkyd Enamel B56.
 - 3. Minimum total dry film thickness 7.0 mil
Sherwin Williams- Universal Metal Primer B50NZ6.
- C. Steel- Galvanized
 - 1. One coat galvanized metal primer.
Sherwin Williams- Galvite Paint B50W30.
 - 2. Two coats alkyd enamel, gloss.
 - 3. Minimum total dry film thickness 6.0 mil.
Sherwin Williams- Silicone Alkyd Enamel B56.

3.08 SCHEDULE-INTERIOR SURFACES

- A. Wood- Transparent Stain
 - 1. One coat stain, Sherwin Williams- One Stain A49.
 - 2. One coat sealer.
Sherwin Williams- Polyurethane Varnish A67VI/A67FI, thin with one pint mineral spirits to one gallon varnish.
 - 3. Two coats Urethane Lacquer, stain. Sherwin Williams- Polyurethane Varnish A67VI/A67FI Minimum dry film thickness 2.0 mil.
- B. Wood- Opaque finish.
 - 1. One coat alkyd primer sealer.
Sherwin Williams- ProMar 200 Alkyd Enamel, undercoat B49W200.
 - 2. Two coats alkyd enamel, gloss.
Sherwin Williams- ProMar 200 Alkyd Gloss B35W251.
 - 3. Minimum total dry film thickness 5.2 mil Enamel.
- C. Steel- Primed
 - 1. Touch-up with original primer.
Sherwin Williams- Universal Metal Primer B50NZ6.
 - 2. Two coats alkyd enamel, gloss.
Sherwin Williams- ProMar 200 Alkyd Enamel.
 - 3. Minimum total dry film thickness 7.0 mil.
- D. Steel- Galvanized
 - 1. One coat galvanized metal primer.
Sherwin Williams- Galvite Paint B50W30.
 - 2. Two coats alkyd enamel, gloss.
Sherwin Williams- Silicone Alkyd Enamel B56.
 - 3. Minimum total dry film thickness 6.0 mil.
- E. Gypsum Board
 - 1. One coat latex primer sealer.
Sherwin Williams- ProMar 200 Latex Wall Primer B28W8200.
 - 2. Two coats alkyd enamel, Eg-Shel.
Sherwin Williams- ProMar 200 Alkyd Eg-Shel Enamel B33W251.
 - 3. Minimum total dry film thickness 4.7 mil.
- F. Cement Masonry Units
 - 1. One coat acrylic latex block filler.
Sherwin Williams- Heavy Duty Block Filler B42W46.
 - 2. One coat Enamel undercoat.
Sherwin Williams- ProMar 200 Alkyd Enamel Undercoater B49W200.
 - 3. Two coats alkyd enamel, Eg-Shel.
Sherwin Williams- ProMar 200 Alkyd Eg-Shel Enamel B33W200.
 - 4. Minimum total dry film thickness 15.6 mil.

END OF SECTION

Section 09900-4

SECTION 10100
MARKER BOARDS AND TACKBOARDS

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete the bulletin boards, and marker boards indicated by the Contract Documents and furnish all supplementary items necessary for its 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.

1.02 SUBMITTALS:

- A. **SAMPLES:**
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. **SHOP DRAWINGS:**
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents:
 - 1. CLARIDGE, or approved equal.
 - 2. TACRITE

2.02 MATERIALS:

- A. ***Provide the following:***
Marker Boards and Tack Boards:
Series 3-factory frame unit satin aluminum frame marker boards 24 gauge LCS on 3/8" particleboard backing with .002 aluminum foil backing. Tack boards shall be FABRICORK 1/4" thick cork on 1/4" thick hard board. Widths and Heights as indicated on drawings. Marker boards to have flag holders and hanger accessories on top.
.

PART 3: EXECUTION:

3.01 INSTALLATION:

- A. Install in accordance with manufacturer's instructions and approved shop drawings. Install accessories plumb, square, level and true with wall or surfaces.
- B. Frames of recessed accessories shall neatly trim the opening. Gaps and voids between frames and finished walls will not be allowed. Exposed and concealed fastening shall match finish or fixtures and shall be stainless steel, theft proof type.
- C. Install concealed anchor plates to wall construction for mounting. Provide grounds or rough bucks, where required, to rigidly secure accessories.

3.02 CLEANING:

- A. Remove all manufacturer's temporary labels or marks of identification. Clean and polish to remove all oil, grease, and foreign material. Leave in a neat, orderly and clean condition acceptable to the Architect.

END OF SECTION

SECTION 10155

TOILET PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid phenolic core toilet compartments.

1.2 RELATED SECTIONS

- A. Section 05120 - Structural Steel: Supports for ceiling hung compartments.
- B. Section 10800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCES

- A. ANSI/ICC A117.1 - Accessible and Usable Buildings and Facilities.
- B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. NEMA LD 3 - High Pressure Decorative Laminates.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's product data for materials, fabrication, and installation including catalog cuts of anchors, hardware, fastenings, and accessories., including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Provide shop drawings for fabrication and installation of compartment assemblies that are not fully described by architectural drawings.
 - 2. Provide template layouts and installation instructions for anchorage devices built into other work.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Submit manufacturer's standard color selector.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years manufacturing toilet partitions.
- B. Installer Qualifications: Minimum 2 years experience installing toilet partitions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Manufacturers storage and handling instruction shall be reviewed and maintained.
- B. Field Measurements: Take field measurements prior to component fabrication to ensure proper fitting of work.
- C. Coordination: Furnish inserts and anchorages that will be built into other work for installation of toilet compartments and related items.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Ampco Products, LLC.; 11400 N. W. 36th Ave., Miami, FL 33167. ASD. Tel: (305) 821-5700. Fax: (305) 507-1414. Email: info@ampco.com. Web: <http://www.ampco.com>
- B. Substitutions: approved equal.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 COMPARTMENTS AND SCREENS

- A. General: Doors, panels, screens, and pilasters assembled into complete compartment system, with cutouts and drilled holes to receive hardware as indicated; processed and fabricated in a craftsmanlike manner; complying with ANSI/ICC A117.1, Americans with Disabilities Act (ADA), and as follows:
- B. Toilet Compartments: Overhead braced.
 - 1. Compartment Depth and Width: As indicated on drawings.
 - 2. Door Width: 24 inches (610 mm), minimum; at wheelchair accessible compartments, 32 inches (813 mm), inside clear minimum.
 - 3. Doors and Panels:
 - a. Top at 70 inches (1778 mm) above finished floor.
 - b. Bottom at 12 inches (305 mm) above finished floor.
 - 4. Pilaster Width: As required to fit space; minimum 3 inches (76 mm).
 - 5. Pilaster Height: 82 inches (2083 mm) including head rail.

- C. Toilet Compartments: Overhead braced, Euroline.
 - 1. Compartment Depth and Width: As indicated on drawings.
 - 2. Door Width: 24 inches (610 mm), minimum; at wheelchair accessible compartments, 32 inches (813 mm), inside clear minimum.
 - 3. Doors, Panels, and Pilasters:
 - a. Top at 78 inches (1981 mm) above finished floor.
 - b. Bottom at 6 inches (152 mm) above finished floor.
 - 4. Pilaster Width: As required to fit space; minimum 3 inches (76 mm).
 - 5. No sight gaps on hinge side or lock side of door.
 - 6. All fasteners and reinforcing concealed from view from outside compartment.
 - 7. Pedestal fastened to floor with concealed anchors.
- D. Toilet Compartments: Floor mounted.
 - 1. Compartment Depth and Width: As indicated on drawings.
 - 2. Door Width: 24 inches (610 mm), minimum; at wheelchair accessible compartments, 32 inches (813 mm), inside clear minimum.
 - 3. Doors and Panels:
 - a. Top at 70 inches (1778 mm) above finished floor.
 - b. Bottom at 12 inches (305 mm) above finished floor.
 - 4. Pilaster Width: As required to fit space; minimum 3 inches (76 mm).
 - 5. Pilaster Height: 70 inches (1778 mm).
- E. Toilet Compartments: Ceiling hung.
 - 1. Ceiling Height: 96 inches (2440 mm) typical. Varies.
 - 2. Compartment Depth and Width: As indicated on drawings.
 - 3. Door Width: 24 inches (610 mm), minimum; at wheelchair accessible compartments, 32 inches (813 mm), inside clear minimum.
 - 4. Doors and Panels:
 - a. Top at 70 inches (1778 mm) above finished floor.
 - b. Bottom at 12 inches (305 mm) above finished floor.
 - 5. Pilaster Width: As required to fit space; minimum 3 inches (76 mm).
 - 6. Bottom of Pilasters: At 12 inches (305 mm) above finished floor.
- F. Toilet Compartments: Floor to ceiling pilasters.
 - 1. Ceiling Height: 96 inches (2440 mm). Varies
 - 2. Compartment Depth and Width: As indicated on drawings.
 - 3. Door Width: 24 inches (610 mm), minimum; at wheelchair accessible compartments, 32 inches (813 mm), inside clear minimum.
 - 4. Doors and Panels:
 - a. Top at 70 inches (1778 mm) above finished floor.
 - b. Bottom at 12 inches (305 mm) above finished floor.
 - 5. Pilaster Width: As required to fit space; minimum 3 inches (76 mm).
- G. Modesty Panels: Floor mounted.
 - 1. Style: Floor leg integral with panel.
 - 2. Style: Floor mounted pilaster.
 - 3. Style: Floor to ceiling pilaster.
 - 4. Depth: As indicated on drawings.
 - 5. Other dimensions same as toilet compartments.
- H. Urinal Screens:
 - 1. Style: Floor leg integral with panel.
 - 2. Style: Pilaster supported.

3. Style: Wall mounted.
4. Depth: 12 inches (305 mm).
5. Depth: 18 inches (457 mm).
6. Depth: 24 inches (610 mm).
7. Height: Top at 70 inches (1778 mm) and bottom at 12 inches (305 mm) above finished floor.
8. Height: Top at 60 inches (1524 mm) and bottom at 18 inches (458 mm) above finished floor.

2.3 SOLID PHENOLIC CORE PANEL COMPONENTS

- A. Doors, Panels, and Pilasters: Solid phenolic core with one piece melamine sheets bonded to phenolic resin impregnated Kraft sheets; exposed edge components polished black, chamfered and free of milling marks.
 1. Material: Class A fire rating when tested in accordance with ASTM E 84.
 2. Color: To be selected from manufacturer's standard colors.
 3. Color: _as selected by School District.
 4. Edges: Polished black.
 5. Edges: PVC edge.
 6. Thickness: Doors and Pilasters, 3/4 inch (19 mm); Panels and Urinal Screens, 1/2 inch (12 mm) minimum.
 7. Thickness: 1/2 inch (12 mm), door finished.
 8. Thickness: 3/4 inch (19 mm) panels.
 9. Thickness: 1 inch (25 mm) pilaster.
- B. Fabrication:
 1. Furnish standard doors, panels, screens and stiles fabricated for compartment system. Furnish units with cutouts and drilled holes to receive compartment hardware as indicated.
 2. One-piece melamine face sheets are bonded under heat and high pressure to phenolic resin impregnated kraft sheets. All exposed edge components shall be polished black, chamfered and free of milling marks. Material shall meet Class B fire rating.
- C. Hardware Set - Standard:
 1. Brackets: Type 304 cast stainless steel pivot hinge with Number 4 satin finish hardware.
 2. Hinges: Heavy duty cast stainless steel, Type 304 with Number 4 finish; two per door.
 - a. Top Hinge: Opposing nylon gravity-acting cam allowing door to be set in various positions.
 - b. Bottom Hinge: Free swinging.
 - c. Emergency access feature for outside access.
 3. Latch and Keeper: Type 304 cast stainless steel with Number 4 finish; slide latch with combination stop and emergency release feature.
 4. Coat Hook: Type 304 cast stainless steel with Number 4 finish; combination hook and bumper on inswinging doors.
 5. Door Pull: Type 304 cast stainless steel with Number 4 finish.
 6. Exposed Fasteners: Chrome plated brass or stainless steel.
- D. Hardware Set - Stainless Steel:
 1. Brackets: Type 304 stamped stainless steel with number 4 satin finish.
 2. Brackets: Continuous aluminum 54-1/2 inches length (1384 mm) clear satin anodized
 3. Brackets: Continuous stamped stainless steel 54-1/2 inches length (1384 mm) number 4 satin finish.

4. Hinges: Cast Type 304 stainless steel with number 4 finish with gravity acting cam allowing doors to be set at various positions.
 5. Hinges: Continuous stainless steel cam 1/4 inch (6 mm) pin- 54-1/2 inches length (1384 mm). Allows doors to fully close for any outswing or handicapped accessible compartments. Inswing doors shall remain open at 20 degrees in rest position.
 6. Hinge: Clear satin anodized aluminum continuous adjustable spring tension hinge 54-1/2 inches length (1384 mm). Cover caps conceal the mounting fasteners.
 7. Latch and Keeper: Type 304 cast stainless steel with Number 4 finish; slide latch with combination stop and emergency release feature.
 8. Coat Hook: Type 304 cast stainless steel with Number 4 finish; combination hook and bumper on inswinging doors.
 9. Door Pull: Type 304 cast stainless steel with Number 4 finish.
 10. Exposed Fasteners: Chrome plated brass or stainless steel.
- E. Hardware Set - Euroline:
1. Material: Powder coated stainless steel finished aluminum.
 2. Material: Powder coated aluminum (white).
 3. Hinges: Fully adjustable self closing, with hinges set to allow door to fall open.
 4. Latch and Keeper/Indicator Bolt: Slide bar on interior with exterior indicator to indicate occupancy; also provide door bumper.
 5. Coat Hook: Wall bumper and garment hook on interior of door with rubber bumper.
 6. Door Pull.
 7. Pedestals: One adjustable height pedestal per side panel of compartment, with ground clearance of 5-1/5 inches (140 mm) to 6-11/16 inches (170 mm).
 8. Exposed Fasteners: Chrome plated brass or stainless steel.

2.4 ACCESSORY MATERIALS

- A. Pilaster Shoes, and Caps: 20 gage (0.9 mm) thick ASTM A 167, Type 304 stainless steel; not less than 3 inches (76 mm) high; Number 4 satin (brushed) finish.
- B. Overhead Bracing: Continuous extruded aluminum, anti-grip profile, with clear satin anodized finish, with returns and anchors.
- C. Anchorages and Fasteners: Manufacturer's standard chromium-plated exposed fasteners finished to match hardware with theft-resistant type heads (one-way).
 1. Concealed Steel Fasteners: Zinc-plated, rust-resistant, protective coating.
 2. Overhead Braced: Galvanized steel supports and leveling bolts at pilasters to suit floor conditions as recommended by manufacturer; provisions for setting and securing overhead bracing at top of each pilaster; pilaster shoe to conceal supports and leveling mechanism.
 3. Floor Mounted: Galvanized steel anchorage devices with threaded rod, lock washers, and leveling adjustment nuts at pilasters to permit structural connection at floor; pilaster shoe to conceal supports and leveling mechanism.
 4. Ceiling Hung: Galvanized steel anchorage devices with threaded rod, lock washers, and leveling adjustment nuts at pilaster connection for structural support above finished ceiling; devices designed to support pilasters from structure without transmitting load to finished ceiling; pilaster shoe to conceal anchorages.
 5. Floor to Ceiling: Galvanized steel supports and/or threaded rod, lock washers, and leveling adjustment nuts at pilasters as required; pilaster shoe to conceal anchorages.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. General: Install in accordance with manufacturer's instructions.
 - 1. Install compartment units rigid, straight, plumb and level.
 - 2. Provide clearance of not more than 1/2 inch (12 mm) between stiles and panels and not more than 1 inch (25 mm) between panels and walls.
 - 3. Secure panels to walls with not less than two brackets attached near top and bottom of panel.
 - 4. Locate wall brackets so holes for wall anchorages occur in masonry or tile joints.
 - 5. Secure panels to stiles with not less than two brackets located to align with brackets at wall.
 - 6. Secure panels in position with manufacturer's recommended anchoring devices.
 - 7. Level, plumb, and tighten installation with devices furnished.
- B. Overhead Braced Compartments:
 - 1. Secure stile to floor.
 - 2. Secure overhead brace to each stile with fasteners supplied.
 - 3. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor Mounted Compartments:
 - 1. Set stile units with anchorages having not less than 2 inches (51 mm) penetration into structural floor, unless otherwise recommended by manufacturer.
 - 2. Hang doors and adjust so tops of doors are level with tops of stiles when doors are in closed position.
- D. Ceiling Hung Compartments:
 - 1. Secure stiles to supporting structure.
 - 2. Hang doors and adjust door so door bottoms are level with bottoms of stiles when doors are in closed position.
- E. Floor to Ceiling Compartments:
 - 1. Secure divider panels to built-in anchorage devices using concealed fasteners.
 - 2. Hang doors and adjust so door bottoms are 12 inches (305 mm) off floor when doors are in closed position.
- F. Screens:
 - 1. Attach with anchoring devices as recommended by manufacturer to suit supporting structure.
 - 2. Set unit to provide support and to resist lateral impact.

- G. EuroLine Compartments:
1. Install compartment units rigid, straight, plumb and level.
 2. Provide clearance of not more than 1/4 inch (6 mm) between pilasters and panels and not more than 3/8 inch (10 mm) between panels and walls.
 3. Secure panels to walls with three stirrup brackets.
 4. Secure panels to pilasters with three stirrup brackets to align with stirrup brackets at wall.
 5. Secure pedestals to floor and level, plumb, and tighten installation with devices furnished.
 6. Secure overhead brace to each pilaster.
 7. For screens: set units to provide support and to resist lateral impact.
- H. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on inswing doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swing doors (and entrance swing doors) to return to fully closed position.

3.4 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on inswing doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swing doors (and entrance swing doors) to return to fully closed position.
- B. Clean and Protect: Clean exposed surfaces of compartment systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

SECTION 10350
FLAGPOLE

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete the Flagpole indicated by the Contract Documents and furnish all supplementary items necessary for its 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.

1.02 SUBMITTALS:

- A. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents:
 - 1. FLAGPOLE: Concord Industries, or approved equal.

2.02 MATERIALS:

- A. Pole shall be cone tapered aluminum commercial ground set flagpole complete with all standard fittings as below listed:
- B. Install concrete foundation with 16 gauge galvanized corrugated steel 12" Ø with, 6"x6"x1/4" base plate, 6" x 6" x 1/4" plate support, 3/4" Ø x 18" long steel lightning ground spike welded to plates, four (4) welded steel wedges.
- C. Pole shall be standard type 30' exposed height, 3'-0" setting depth; 33' total length. Outside butt diameter shall be 6", tapered top dia. 3 1/2", 6" dia. ball, provide four (4) bronze swivel type snap nooks, with aluminum flash collar.
- D. Flagpole shall have wall thickness throughout of not less than .188" and shall have uniform conical taper throughout tapered portion. Pole shall be machine made of 6063-T6 seamless extruded aluminum; NOT from rolled plate with welded seam. Pole must have smooth uninterrupted exterior surface without visible offsets. Pole shall be shipped in one piece. Exterior surface shall have "ultrasheen" finish. Painting will not be permitted. Prior to shipment, pole shall be heavily spiral-wrapped with polyethylene and further protected during transit.

PART 3: EXECUTION:

- A. Install in accordance with manufacturer's written requirements and details.

END OF SECTION

SECTION 10420
BUILDING PLAQUE AND LETTERS

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete building plaque seal and letters the indicated by the Contract Documents and furnish all supplementary items necessary for its 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.

1.02 SUBMITTALS:

- A. SAMPLES:
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents:
 - 1. ACCESSORIES: SOUTHWELL COMPANY, ARK RAMOS, or approved equal.

2.02 MATERIALS:

- 1. Tablet shall be cast from high quality aluminum ingots. Casting shall be free of all pits and holes and all letters shall be sharp and hand tooled.
- 2. Border and faces of raised letters shall be stain finished and background shall be stippled and finished and oxidized. Two protective coatings of clear lacquer shall be sprayed on completed tablet.
- 3. Tablet shall be standard edge and no-border design. Letter Style: Modern block; 18"x24".
- 4. The design shall consist of more than two {2} sizes of letters; shall have those names: *of the School Board Members, Superintendent, plus the Architects and Contractor plus the name of the project.*

PART 3: EXECUTION:

3.01 INSTALLATION:

- A. Install in accordance with manufacturer's instructions and approved shop drawings. Install plaque plumb, square, level and true with wall or surfaces.

3.02 CLEANING:

- A. Remove all manufacturer's temporary labels or marks of identification. Clean and polish to remove all oil, grease, and foreign material. Leave in a neat, orderly and clean condition acceptable to the Architect.

PART 4: IDENTIFYING DEVICES:

4.01 LETTERING:

- A. Building Cast letters shall be those manufactured by the A.R.K. RAMOS, or approved equal . Letters shall be **Forty-five {45}** 30" letters. Contact architect for wording required. Style to be determined during submittals, capital letters.

4.02 MATERIALS:

- A. Baked enamel letters shall be cast aluminum alloy and surfaced smooth.
- B. Baked enamel letters shall be primed and spray coated with two {2} coats of baking enamel, each coat baked separately. Letter colors shall be selected by Architect.

4.03 INSTALLATION:

- A. Letters shall be mounted where directed by Architect.
- B. Projected from surface 3/4" using metal (collars/brackets) and masonry anchors.

END OF SECTION

SECTION 10441
IDENTIFICATION SIGNAGE

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete IDENTIFICATION SIGNAGE indicated by the Contract Documents and furnish all supplementary items necessary for its 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.

1.02 SUBMITTALS:

- A. SAMPLES:
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2: PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents:
 - 1. ACCESSORIES: SOUTHWELL COMPANY, or approved equal.

2.02 MATERIALS:

- A. IDENTIFYING DEVICES:
 - 1. ***Provide (130) ONE HUNDRED THIRTY ADA compliance, 6" x 8" signs, style no. ADA SS-4, wall mounted***
 - 2. ***Provide (22) TWENTY-TWO ADA compliance, 6"x8" Restroom signs, style no. SS-7, wall mounted***
- B. All identification signage must meet the following guidelines:
 - 1. Vendor to provide signs that comply with the Americans with Disability Act Accessibility Act Guidelines and these specifications.
 - 2. CONSTRUCTION: Braille, lettering, and pictographic are to be an integral part of the sign.
 - 3. BRAILLE CHARACTERS: Grade 2; Raised 1/32" ,placed below tactile characters.
 - 4. TACTILE CHARACTERS: Raised 1/32", Upper case letters.
 - 5. TYPESTYLES: Vendor shall supply Architect with typestyles available.
 - 6. CHARACTER HEIGHT: 3/4" AND 5/8".

7. SPACING: Spacing between vertical elements of the characters shall be 1/8" min. Spacing between characters and braille shall be 3/16" min.
8. DIMENSIONS FOR BRAILLE: Dot diameter- .059 in., Inter-dot spacing - .090 in., Horizontal separation between cells -.241 in., Vertical separation between cells - .395 in.
9. PICTOGRAMS: Raised 1/32", Written description with accompanied braille placed directly below the symbol.
10. FINISH and CONTRAST: Non-glare finish. White characters on a solid background. Color to be selected by Architect, from standard colors.
11. ASSURANCE: A written assurance that all Braille is correct is required.
12. Certification by the manufacturer that its product design and construction complies with Section 4.30 of the ADA Accessibility Guidelines must accompany bid.
13. INSTALLATION: The signs are to be wall mounted in frame on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, signs shall be placed on the nearest adjacent wall. Mounting height shall be 60" above the finish floor to the centerline of the sign. Mounting location shall be so that a person may approach within 3" of signage without encountering protruding objects or standing within the swing of a door.

PART 3: EXECUTION:

3.01 CLEANING:

- A. Remove all manufacturer's temporary labels or marks of identification. Clean and polish to remove all oil, grease, and foreign material. Leave in a neat, orderly and clean condition acceptable to the Architect.

END OF SECTION

SECTION 10520
FIRE EXTINGUISHERS

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Fire Extinguishers 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.

1.02 SUBMITTALS

- A. Samples
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. Shop Drawings
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies~ with the Contract Documents.
 - 1. FIRE EXTINGUISHERS
 - J.L. Industries
 - Larsen's Manufacturing Co.
 - Muckle Mfg. Co. - Div. of Technico, Inc.
 - Profile International, Inc.
 - Seco Mfg., Inc.

2.02 MATERIALS

- A. FIRE EXTINGUISHERS. *J.L. Industries "Cosmic Model 10E, UL 4A-60BC (A, B, C fire class).*
- B. FIRE EXTINGUISHER CABINETS: *J.L. Industries Ambassador 1017G10 ADAC OPTION with continuous hinge solid door. White epoxy coated cold rolled steel tubs, trim and door. Fire-EX OPTION.*
- C. Require (10) TEN of extinguishers and (10) TEN cabinets noted on drawings.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's latest written requirements and details.

END OF SECTION

SECTION 10530
EXTRUDED ALUMINUM CANOPIES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish a complete extruded aluminum walkway cover system including labor as shown on the drawings.

1.2 RELATED WORK

- A. Concrete Footings
- B. Flashing
- C. Sealants
- D. Electrical Work
- E. Masonry

1.3 SUBMITTALS

- A. Furnish complete shop drawings bearing the seal of a registered engineer showing the required live and wind loads of the project.
- B. Submit samples of the finish and color selections.
- C. Submit manufacture's brochures and product data.

1.4 QUALITY ASSURANCE

- A. Installation shall be done by the manufacturer of the aluminum canopy to ensure a single source responsibility for the work.

1.5 WARRANTY

- A. Provide one year warranty against defects in materials, workmanship and installation.

PART 2 – MATERIALS

2.1 MANUFACTURERS

- A. **AVAdesk** walkway cover systems and canopies submitted, 9201 Winkler Drive, Houston, Texas 77017, 713-944-0988.
- B. **East Texas Canopy, Inc.** protective covers and canopy systems, 11221 Cr 2130, Whitehouse, Texas 75791, 800-816-3822

2.2 COMPONENTS

- A. All components shall be 6061-T6 or 6005-T5 Alloy extruded aluminum, Sizing and selection components shall meet the requirements of the project.
- B. Columns, beams, and deck shall be sized as shown on the drawings and shall meet the engineering requirements of the project. In the event that component sizes are different than those listed in paragraph A. Price the greater size component.
- C. FINISHES
Deck: **Kynar, color to be selected by Architect**
Trim: **Kynar, color to be selected by Architect**
Beams: **Kynar, color to be selected by Architect**

SECTION 10530
EXTRUDED ALUMINUM CANOPIES

Columns: *Kynar, color to be selected by Architect*

- D. Fasteners shall be concealed as much as is possible. Material shall be stainless steel or specially coated to provide for long life durability.

PART 3 – EXECUTION

3.1 FABRICATION

- A. Columns and beams shall be heliarc welded.
- B. The canopy deck is to have welded end closures at the deck terminations.
- C. The canopy shall be fabricated to drain through the columns.
- D. Flashing shall be .040 aluminum fabricated to prevent leakage between the canopy and adjacent structures.

3.2 INSTALLATION

- A. Install the canopy in strict accordance with the manufacturer's recommendations.
- B. Erect canopy after concrete and masonry work in vicinity is completed and washed down.
- C. Install columns and beams straight and true.
- D. Install rain caps over draining sections of the deck.
- E. The general contractor shall finish the concrete around the columns to assure a uniform quality of workmanship and appearance with the adjacent surrounding concrete work.
- F. Fill downspout columns with grout to the discharge level to prevent standing water. Deflectors should be installed after grouting.
- G. Install flashing as required.
- H. Care shall be taken to prevent damage or scratching during installation.
- I. Thoroughly clean canopy after installation.

END OF SECTION

SECTION 10801

TOILET AND BATH 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. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.
- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: [15] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:
 - 1. A & J Washroom Accessories, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.

4. American Specialties, Inc.
5. Kimberly Clark
6. Rubbermaid
7. Georgia Pacific

B. Toilet Tissue (double roll) Dispenser - Provide one per toilet.

1. Basis-of-Design Product: Georgia Pacific #GP57120.

C. Paper Towel (Roll) Dispenser Provide one per lavatory in single lavatory toilet room.

1. Basis-of-Design Product: Provide one per 2 lavatories in multi-lavatory toilets. Provide one per sink. Kimberly Clark #K9736.

D. Liquid-Soap Dispenser for students toilet rooms:

1. Basis-of-Design Product: Kimberly Clark #91180

E. Liquid Foam soap dispenser for staff restrooms, teachers lounge and kitchen lavatories

1. Basis of Design Product: Kimberly Clark #92144

F. Grab Bar : Provide one 42" side bar per H.C. toilet.

1. Basis-of-Design Product: Provide on 36" rear bar per H.C. toilet, Bobrick B-6806.

G. Sanitary-Napkin Disposal Unit : Provide one per toilet serving females.

1. Basis-of-Design Product: Rubbermaid #6140

H. Feminine Napkin Dispensers:

1. Basis of Design: Metal Modes #8n or Kotex #8

I. Mirror Unit : Provide one at each lavatory.

1. Basis-of-Design Product: Bobrick B-165
2. Size: 24" x 40"

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod : Provide one at each shower.

1. Basis-of-Design Product: Bobrick B-207

B. Shower Curtain: Provide one at each shower.

1. Basis-of-Design Product: Bobrick 204-2
2. Size: Minimum [6 inches (152 mm)] wider than opening by 72 inches (1828 mm) high.
3. Color: [White].

4. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

C. Folding Shower Seat: Provide one per H.C. shower.

1. Basis-of-Design Product: Bobrick B-5181
2. Seat: [Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect].
3. Mounting Mechanism: [Stainless steel, No. 4 finish (satin)].

2.4 WARM-AIR DRYERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A & J Washroom Accessories, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. World Dryer Corporation.

B. Warm-Air Dryer : Provide as indicated on drawings.

1. Basis-of-Design Product: Bobrick B-7507.
2. Mounting: [Semirecessed].
3. Operation: [Touch-button] activated with timed power cut-off switch.
 - a. Operation Time: [30 to 40] seconds.
4. Electrical Requirements: 115 V, 20 A, 2300 W.

2.5 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following]:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard : Provide at each lavatory with exposed plumbing.

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements.

1. A & J Washroom Accessories, Inc.
2. Bobrick Washroom Equipment, Inc.

3. Bradley Corporation.
4. Rubbermaid
5. Kimberly Clark

B. Mop and Broom Holder: Provide one per custodial closet.

1. Basis-of-Design Product: Rubbermaid #1993 and #1994

C. Paper Towel (Roll) Dispenser : Provide one per custodial closet.

1. Basis-of-Design Product: Kimberly Clark #K9736.

2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [six] <Insert number> keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10801

SECTION 10830
MIRROR UNITS

PART 1:- GENERAL

1.01 DESCRIPTION

- A. Perform all work required to complete the mirror units indicated by the Contract Documents and furnish all supplementary items necessary for their proper installation.
- B. The requirements of Division O - "Bidding and Contract Requirements" and Division 1 - "General Requirements" of this Project Manual shall apply to all work required for this section.

1.02 SUBMITTALS

- A. Samples
 - 1. Submit for approval samples of typical mirrors showing construction and finish specified.
- B. Shop Drawings
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - A & J United Machine & Metal Products Corp.
 - American Specialties, Inc.
 - Bobrick Washroom Equipment, Inc.
 - Bradley Corp.
 - Hallmack-NuTone/Div. Scovil
 - G. M. Ketcham Company, Inc.
 - F. H. Lawson Co.
 - Meek Manufacturing Co., Inc.
 - McKinney/Kidde, Inc.
 - Parker - Scovill
 - P. D. Metal Industries
 - Tubular Specialties Mfg., Inc.
 - Watrous, Inc.

2.02 MATERIALS

- A. ***Mirror Glass: 1/4" thick, Type I, Glass 1, Quality Q2, conforming to FS DD-G-451, with silvering, copper coating, and protective organic coating complying with FS DD-M-411.***
- B. ***Framing: Manufacturer's standard alloy aluminum. Smooth corner's.***

2.03 FABRICATION

- A. General:
 - 1. Edge Protection: Fabricate frames for glass mirrors to accommodate wood, felt, plastic, or other glass edge protection material.
 - 2. Backing: Provide mirror backing and support system which will permit rigid, Damperproof glass installation and prevent accumulation of moisture, as follows:
 - a) Galvanized steel backing sheet, not less than 22 gage and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.
 - 3. Hangers: Provide system of mounting mirror units which will permit rigid, tamperproof and theftproof installation, as follows:
 - a) One-piece galvanized steel wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts, OR, AT CONTRACTOR'S OPTION:

- b) Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

3.02 ADJUST AND CLEAN

- A. Clean exposed surfaces of mirror units in compliance with manufacturer's recommendations.

END OF SECTION

SECTION 11010
MISCELLANEOUS EQUIPMENT

PART 1 - GENERAL:

1.1 SCOPE:

- A. Perform all work required to supply the MISCELLANEOUS EQUIPMENT 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.

1.2 RELATED WORK:

- A. Specialty Items.

1.3 SUBMITTALS:

- A. SAMPLES:
 - 1. Submit for approval samples of typical accessories showing construction and finish specified.
- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.
- C. ACCEPTABLE MANUFACTURERS:
 - 1. Draper Inc.
 - 2. Dal-Lite.

PART 2: PRODUCTS

2.1 PRODUCTS

- A. **PROJECTION SCREENS:**
 - 1. At *each classroom* provide one (1) Model 'B' 60" x 60" projection screen with wall brackets No. 11 as manufactured by Da-Lite Screen Co. Inc. P.O. Box 173 Warsaw, Indiana 46580 (219) 267-8101.
- B. **WINDOW BLINDS:**
 - 1. At *each classroom exterior* window provide and install *Draper, Inc., Heavy Duty cadmium plated hardware roller shades with Sunbloc Series B900 Fabric #SB9110.*
 - 2. 1" 0 metal roller.
 - 3. Install inside window jamb.
 - 4. Provide wood blocking (ground)
 - 5. Size shade same size as window.
 - 6. Install window shades according to manufacturer's instructions and approved shop drawings.

END OF SECTION

SECTION 14240
MACHINE ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Machine room-less 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. Operation and control systems.
4. Jack(s).
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 16 Sections:
 - a. Providing electrical service to elevators, including fused disconnect switches where permitted. (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 control room (if applicable), hoistway and pit.
7. Division 22 Plumbing
 - a. Sump pit and oil interceptor.
8. Division 23 Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.

- 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, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the thyssenkrupp Elevator's proposal, since it is a part of the building construction.

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. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
22. For signal systems and power operated door: provide ground and branch wiring circuits.
23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
24. 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.

25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc..

1.02 SUBMITTALS

- A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings:
 - 1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. 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. Owner's manuals and wiring diagrams.
 - 2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
 - 1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured by the installing company, 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 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:

1. ASME 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. Section 407 in ICC A117.1, when required by local authorities
7. CAN/CSA C22.1 Canadian Electrical Code
8. CAN/CSA B44 Safety Code for Elevators and Escalators.
9. 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 Standard 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:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

F. Sustainable Product Qualifications:

1. Environmental Product Declaration:
 - a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
 - b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
2. Material Transparency:
 - a. GOOD: Provide Health Product Declaration at any level
 - b. BETTER: Provide Health Product Declaration (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.
 - c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.
3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
4. Living Building Challenge Projects: Provide Declare label for products specified.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing shall 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. Temporary 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 final acceptance.

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.
 - 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
 - 2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
 - 3. 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: Design based around thyssenkrupp Elevator's endura Machine Room-Less hydraulic 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 full range of standard colors, patterns, and finishes.
- 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 by others.

2.03 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. 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 bolted or welded 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.
- D. Guides: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: A 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..
- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. 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.
- H. 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. theoiltype
- I. 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.

- J. 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: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

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 (where required), 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 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 PASSENGER ELEVATOR CAR ENCLOSURE

- A. Car Enclosure:
 1. Walls: Cab type a laminate wall design, durable wood core finished on both sides with high pressure plastic laminate.
 2. Reveals and frieze: Not applicable
 3. Canopy: Cold-rolled steel with hinged exit.
 4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a factory applied powder coat finish.
 5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with No. 4 brushed stainless steel

6. 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 finish.
 - b. Cab Sills: Extruded aluminum, mill finish.
 7. Handrail: Provide 2" flat metal bar 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.
 8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
 9. Protection pads and buttons: Not required
- 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 shall 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 or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical 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. 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 shall reverse and the door shall 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 shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.

5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall 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 shall 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 Device: Provide a door protection system using 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. Wrap return shall have a No. 4 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: Not Applicable

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. 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.
- E. Special Operation: Not Applicable

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.
1. Provide one pushbutton riser with faceplates having a No. 4 brushed stainless steel finish.
 - a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
- 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: Not Applicable
- 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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, 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.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. 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.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. 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.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

- G. 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.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. 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 and recommended by Code and governing regulations or agencies. 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 steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-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: enduraMRL Above-Ground (2-Stage)
 - 2. Elevator Type: Hydraulic Machine Room-Less, Passenger
 - 3. Rated Capacity: 2100 lbs.
 - 4. Rated Speed: 80 ft./min.
 - 5. Operation System: TAC32H
 - 6. Travel: 14'-8"
 - 7. Landings: 2 total
 - 8. Openings:
 - a. Front: 2
 - b. Rear: 0
 - 9. Clear Car Inside: 5' - 8" wide x 4' - 3" deep
 - 10. Cab Height: 8'-0" standard
 - 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. Hoistway Dimensions: 7' - 4" wide x 5' - 9" deep
 - 16. Pit Depth: 4' - 0"
 - 17. Button & Fixture Style: Signa4 Signal Fixtures
 - 18. Special Operations: None

3.09 SPECIAL CONDITIONS (Note: Add Special Conditions as Needed)

END OF SECTION

5/21/2018

DIVISION 15 – MECHANICAL

- 15010 SUMMARY OF MECHANICAL WORK
- 15050 BASIC MECHANICAL MATERIALS AND METHODS
- 15060 HANGERS AND SUPPORTS
- 15070 SUPPORTS AND ANCHORS
- 15075 MECHANICAL IDENTIFICATION
- 15081 DUCT INSULATION
- 15083 PIPE INSULATION
- 15110 VALVES
- 15122 METERS AND GAUGES
- 15140 DOMESTIC WATER PIPING
- 15150 SANITARY WASTE AND VENT PIPING
- 15181 HYDRONIC PIPING
- 15183 REFRIGERANT PIPING
- 15185 HYDRONIC PUMPS
- 15190 SYSTEM IDENTIFICATION AND PIPE MARKING
- 15240 SOUND AND VIBRATION CONTROL
- 15330 WET TYPE FIRE SPRINKLER SYSTEM
- 15410 PLUMBING FIXTURES
- 15415 DRINKING FOUNTAINS AND WATER COOLERS
- 15430 PLUMBING SPECIALTIES
- 15485 ELECTRIC, DOMESTIC WATER HEATERS
- 15488 VARIABLE FREQUENCY DRIVES
- 15545 CHILLED AND HOT WATER TREATMENT SYSTEMS
- 15800 CHILLED WATER AIR HANDLING UNITS
- 15815 METAL DUCTS
- 15820 DUCT ACCESSORIES
- 15837 CENTRIFUGAL FANS
- 15845 AIR TERMINAL UNITS
- 15855 DIFFUSERS, REGISTERS, AND GRILLES
- 15860 AIR COOLED SCROLL WATER CHILLERS
- 15900 HVAC CONTROLS
- 15990 TESTING, ADJUSTING, AND BALANCING



DIVISION 16,17 – ELECTRICAL

- 16010 SUMMARY OF ELECTRICAL WORK
- 16020 BASIC ELECTRICAL REQUIREMENTS
- 16050 BASIC ELECTRICAL MATERIALS AND METHODS
- 16055 SITE ELECTRICAL
- 16060 GROUNDING AND BONDING
- 16075 ELECTRICAL IDENTIFICATION
- 16120 BUILDING WIRE AND CABLE
- 16130 RACEWAYS AND BOXES
- 16139 CABLE TRAYS
- 16140 WIRING DEVICES
- 16190 SUPPORT DEVICES
- 16425 SWITCHBOARD
- 16440 DISCONNECT SWITCHES
- 16442 PANELBOARDS



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16475	FUSES
16511	INTERIOR LIGHTING
16515	LIGHTING CONTROL SYSTEM
16521	EXTERIOR LIGHTING
16693	BRANCH CIRCUIT PANELBOARD POWER CONDITIONING SURGE PROTECTION DEVICE
16721	FIRE ALARM / LIFE SAFETY SYSTEMS
16726	INTRUSION DETECTION SYSTEM
16741	TELEPHONE AND DATA COMMUNICATIONS
16770	INTERCOM COMMUNICATIONS SYSTEMS
17200	IN-CEILING CLASSROOM AUDIO SYSTEM

SECTION 15010
SUMMARY OF MECHANICAL 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 15 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. Mechanical Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC
3533 Moreland Dr. Ste. A
Weslaco, Texas 78596
Phone Number: (956) 973-0500
Contact Person: Leonardo Munoz, P.E.

- C. General Scope of Work:

1. Install AC equipment and ductwork as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect power to unit.
2. HVAC: Provide all materials and labor associated with a complete operational installation of new HVAC systems including, but not limited to:
 - Chilled Water Central Station Units
 - DX Air Handlers & RTU's
 - Exhaust fans
 - Sheet metal, Ductwork
 - Diffusers and Grilles
 - Duct accessories, including grilles, and louvers
 - HVAC Controls
 - Air Test and Balance

1.3 CONTINGENCY

1. Refer to architectural specifications for Mechanical Contingencies.

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, even in areas where only mechanical work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.

- D. 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.
- E. Fully coordinate with electrical contractor for providing power to mechanical equipment.
- F. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls' system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls' system.

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.

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.

1.7 SUBMITTALS

- 1. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire mechanical or plumbing in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Escutcheons.
 - 4. Dielectric fittings.
 - 5. Flexible connectors.
 - 6. Mechanical sleeve seals.
 - 7. Equipment nameplate data requirements.
 - 8. Nonshrink grout for equipment installations.
 - 9. Field-fabricated metal and wood equipment supports.
 - 10. Installation requirements common to equipment specification sections.
 - 11. Cutting and patching.
 - 12. Touchup painting and finishing.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 2. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 3. Sizes and location of required concrete pads and bases.
 4. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 5. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.

- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
- C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.

1.9 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.
- B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
- C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.
- D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to insure that the equipment will not be damaged in any way during the associated construction procedures.

1.10 START-UP OF EQUIPMENT AND SYSTEMS

- A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
- B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.

1.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.
- D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

1.12 ACCEPTABLE MANUFACTURERS

- A. Provide equipment and materials from listed manufacturers listed within this specification. Deviations from this specification will not be acceptable. When one manufacturer is listed, alternate materials and equipment may be provided "equal to" the listed. When more than one manufacturer is listed, equipment and material must be provided by one of the listed manufacturers.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

- A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.
- B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

2.2 QUALITY AND CLASSIFICATION OF MATERIALS

- A. Materials and equipment shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials or equipment identical with those damaged.
- B. Wherever a UL standard has been established for a particular type of material or equipment, each such material or equipment provided on this project shall meet the requirements of the UL standard in every way and shall be UL listed and labeled.

2.3 LOCAL PARTS AND SERVICE

- A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles of the project site."

2.4 FLAME SPREAD PROPERTIES OF MATERIALS

- A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dielectric Unions:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Industries, Inc.; Wilkins Div.
 - 2. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.6 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.7 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAgl: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 2. PVC to ABS Piping Transition: ASTM D 3138.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.8 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

2.9 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.10 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.

2.11 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 15 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials: Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 for materials.

5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as

- possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. PVC Nonpressure Piping: ASTM D 2855.
 - c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT AND MATERIAL INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment and ductwork giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

- A. Refer to Division 9 for paint materials, surface preparation, and application of paint.

- B. Do not paint piping specialties with factory-applied finish.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive-strength concrete and reinforcement or as specified in Division 3.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.7 GROUTING

- A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 15060
HANGERS AND SUPPORTS

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 hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 5 Sections for materials for attaching hangers and supports to building structure.
 - 2. Division 13 Sections on fire-suppression piping for fire-suppression pipe hangers.
 - 3. Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for vibration isolation and seismic restraint devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.
 - 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers:
 - a. Globe Pipe Hanger Products, Inc.
 - b. Grinnell Corp.
 - c. Michigan Hanger Co., Inc.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 3. Extension Hinged Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. C-Clamps (MSS Type 23): For structural shapes.
 5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 6. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 7. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. 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.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- I. Insulated Piping: Comply with the following:
 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 according to ASME B31.9.
 2. 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 inserts.
- 6. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.4 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION

SECTION 15070
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe, and equipment hangers, supports and associated anchors.
- B. Sleeves and seals.
- C. Flashing and sealing equipment and pipe stacks.

1.02 RELATED WORK

- A. Section 15240 - Vibration Isolation.
- B. Section 15260 - Piping Insulation.
- C. Section 15280 - Equipment Insulation.
- D. Section 15330 – Wet Pipe Fire Protection Sprinkler System.
- E. Section 15410 - Plumbing Piping and Valves.
- F. Section 15510 - Hydronic Piping.
- G. Section 15530 – Refrigerant Piping

1.03 REFERENCES

- A. ANSI/ASME B31.1 - Power Piping.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- C. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.04 QUALITY ASSURANCE

- A. Supports for Sprinkler Piping: In conformance with NFPA 13.
- B. Supports for Standpipes: In conformance with NFPA 14.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division One.
- B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 to 4 Inches Carbon steel, adjustable, clevis.
- C. Hangers for Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for pipe sizes 6 inches and over.
- E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 Inches and over: adjustable steel yoke and cast iron roll.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- I. Floor Support for Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- J. Roof Pipe Supports and Hangers: Galvanized Steel Channel System as manufactured by Portable

- Pipe Hangers, Inc. or approved equal.
 For pipes 2-1/2" and smaller – Type PP10 with roller
 For pipes 3" through 8" – Type PS
 For multiple pipes – Type PSE - Custom
- K. Copper Pipe Support and Hangers: Electro-galvanized with thermoplastic elastomer cushions; Unistrut "Cush-A-Clamp" or equal. Hangers: Plastic coated; Unistrut or equal.
 - L. For installation of protective shields refer to specification section 15140-3.03.
 - M. Shields for Vertical Copper Pipe Risers: Sheet lead.
 - N. Pipe Rough-In Supports in Walls/Chases: Provide preformed plastic pipe supports, Sioux Chief "Pipe Titan", Holdrite or equal.

2.02 HANGER RODS

- A. Galvanized Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

- A. Metal Flashing: 20 gage galvanized steel.
- B. Lead Flashing: 4 lb. /sq. ft. sheet lead for waterproofing; 1 lb. /sq. ft. sheet lead for soundproofing.
- C. Caps: Steel, 20 gage minimum; 16 gage at fire resistant elements.
- D. Coordinate with roofing contractor/architect for type of flashing on metal roofs.

2.05 EQUIPMENT CURBS

- A. Fabricate curbs of hot dipped galvanized steel.
 - 1. Provide with hurricane clip to anchor RTU to roof curb.
- B. For metal roof construction, roof curbs shall be made of aluminum or stainless steel. Coordinate with architectural drawings and details.

2.06 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors: Form with 18 gage galvanized steel, tack welded to form a uniform sleeve.
- B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe, schedule 40.
- C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated steel sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Form with galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- F. Fire Stopping Insulation: Glass fiber type, non-combustible, U.L. listed.
- G. Caulk: Paintable 25-year acrylic sealant.
- H. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted, two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.07 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- B. Design hangers without disengagement of supported pipe.
- C. Design roof supports without roof penetrations, flashing or damage to the roofing material.

2.08 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.01 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Coordinate with structural engineer for placement of inserts.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. Verify with structural engineer prior to start of work.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
(Steel Pipe)		
1/2 to 1-1/4 inch	7'-0"	3/8"
1-1/2 to 3 inch	10'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"
12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(Copper Pipe)		
1/2 to 1-1/4 inch	5'-0"	3/8"
1-1/2 to 2-1/2 inch	8'-0"	3/8"
3 to 4 inch	10'-0"	3/8"
6 to 8 inch	10'-0"	1/2"
(Cast Iron)		
2 to 3 inch	5'-0"	3/8"
4 to 6 inch	10'-0"	1/2"
8 to 10 inch	10'-0"	5/8"

12 to 14 inch	10'-0"	3/4"
15 inch and over	10'-0"	7/8"
(PVC Pipe)		
1-1/2 to 4 inch	4'-0"	3/8"
6 to 8 inch	4'-0"	1/2"
10 and over	4'-0"	5/8"

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow and at the vertical horizontal transition.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Install hangers with nut at base and above hanger; tighten upper nut to hanger after final installation adjustments.
- J. Portable pipe hanger systems shall be installed per manufacturers' instructions.
- K. Distances between supports are maximum distance. Supports shall be provided to carry the pipe/equipment load.

3.03 INSULATED PIPING: COMPLY WITH THE FOLLOWING INSTALLATION REQUIREMENTS.

- A. Clamps: Attach galvanized clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
- B. Saddles: Install galvanized protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
- C. Shields: Install protective shields MSS Type 40 on cold and chilled water piping that has vapor barrier. Shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

NPS	LENGTH	THICKNESS
1/4 THROUGH 3-1/2	12	0.048
4	12	0.060
5 & 6	18	0.060
8 THROUGH 14	24	0.075
16 THROUGH 24	24	0.105

- D. Piping 2" and larger provide galvanized sheet metal shields with calcium silicate at hangers/supports.
- E. Insert material shall be at least as long as the protective shield.
- F. Thermal Hanger Shields: Install where indicated, with insulation of same thickness as piping.

3.04 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.05 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 8 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter flash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor shower mop sink and all other drains watertight to adjacent materials.
- E. Provide curbs for mechanical roof installations 8 inches minimum high above roofing surface. Contact architect for all flashing details and roof construction. Seal penetrations watertight.

3.06 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors minimum one inch above finished floor level. Caulk sleeves full depth with fire rated thermfiber and 3M caulking and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with U.L. listed fire stopping insulation and caulk seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Fire protection sleeves may be flush with floor of stairways.

END OF SECTION

SECTION 15075
MECHANICAL IDENTIFICATION

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 mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Access panel and door markers.
 - 4. Pipe markers.
 - 5. Duct markers.
 - 6. Valve tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.

- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme [approved by Architect] <Insert other>. Provide 5/32-inch (4-mm) hole for fastener.
 - 1. Material: 3/32-inch- (2.4-mm-) thick laminated plastic with 2 black surfaces and white inner layer.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - 2. Heat exchangers, coils, evaporators, and similar equipment.
 - 3. Fans, blowers, primary balancing dampers, and mixing boxes.
 - 4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.

- c. Orange: For combination cooling and heating equipment and components.
- 2. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices.
 - b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - c. Heat exchangers, coils, evaporators, and similar equipment.
 - d. Fans, blowers, primary balancing dampers, and mixing boxes.
 - e. Packaged HVAC central-station and zone-type units.
 - f. Tanks and pressure vessels.
 - g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least **1-1/2 inches (38 mm)** wide, lapped at least **3 inches (75 mm)** at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 4. Letter Size: Minimum **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and

proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of **50 feet (15 m)** in each space where ducts are exposed or concealed by removable ceiling system.

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; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices 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:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: **1-1/2 inches (38 mm)**, round.
 - b. Hot Water: **1-1/2 inches (38 mm)**, round.
 - c. Fire Protection: **2 inches (50 mm)**, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Yellow.
 - c. Fire Protection: Red.
 - 3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Fire Protection: White.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 15081
DUCT INSULATION

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 semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 7 Sections for firestopping materials and requirements for penetrations through fire and smoke barriers.
 - 2. Division 15 Section "Pipe Insulation" for insulation for piping systems.
 - 3. Division 15 Section "Metal Ducts" for duct liner.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Deliver and store all insulation with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.

- C. Any installed insulation left temporarily incomplete shall be covered with protective material until final connections can be installed.

1.6 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 - 1. Tape Width: 4 inches (100 mm).
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- 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 APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 2. Install anchor pins and speed washers on sides and bottom of horizontal ducts and all sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.

3. Impale insulation over anchors and attach speed washers.
4. 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.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
 1. Indoor concealed supply-, return-, exhaust and outside-air ductwork.
 2. Indoor exposed supply-, return-, exhaust and outside-air ductwork.
 3. Indoor concealed range-hood exhaust ductwork.
 4. Indoor concealed dishwasher ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Factory-insulated flexible ducts.
 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 3. Flexible connectors.
 4. Vibration-control devices.
 5. Testing agency labels and stamps.
 6. Nameplates and data plates.
 7. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. Service: Round and rectangular, supply-air ducts, concealed.
 1. Material: Mineral-fiber blanket.
 2. Thickness: 2 inches (50 mm).
 3. Number of Layers: One.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
- B. Service: Round and rectangular, return-air and exhaust ducts, concealed.

1. Material: Mineral-fiber blanket.
 2. Thickness: 2 inches (50 mm).
 3. Number of Layers: One.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
- C. Service: Round and rectangular, outside-air ducts, concealed and exposed.
1. Material: Mineral-fiber blanket.
 2. Thickness: 2 inches (50 mm).
 3. Number of Layers: One.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
- D. Service: Round and rectangular, supply and return-air ducts, exposed.
1. Material: Mineral-fiber glass, R-Value 4 or greater, density 3.0lbs/c.f.
 2. Thickness: Double wall ductwork
 3. Number of Layers: One.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
- E. Service: Round and rectangular, return-air ducts drops to space:
- 1.Type D6: Ductliner (to be used in return air sound boots only), flexible glass fiber; ASTM C1071; Type II, 'k' value of 0.23 at 75 degrees F; 3.0 lb/cu ft minimum density; coating air side for maximum 4,000 feet per minute air velocity.

END OF SECTION

SECTION 15083
PIPE INSULATION

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 preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
 - 1. Division 2 for loose-fill pipe insulation in underground piping outside the building.
 - 2. Division 7 for fire-stopping materials and requirements for penetrations through fire and smoke barriers.
 - 3. Division 15 Section "Duct Insulation" for insulation for ducts and plenums.
 - 4. Division 15 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
 - 5. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
 - 2. Cellular-Glass Insulation:
 - a. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - 3. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - 3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.

6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
 1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- C. Closed-Cell Phenolic-Foam Insulation: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
- D. Flexible Elastomeric Thermal Insulation used on Refrigerant Piping: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 1. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil.
- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.
 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.
- D. Aluminum Jacket: Factory cut and roll to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 1. Finish and Thickness: Smooth finish, 0.010 inch (0.25 mm) thick.
 2. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and Kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- E. 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.
 1. Products:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 - 1. Tape Width: 4 inches (100 mm).
- B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:
 - 1. Aluminum: 0.007 inch (0.18 mm) thick.

2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry during application and finishing.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

- I. Apply insulation with the least number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply 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 (100 mm) o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Fire-stopping and fire-resistive joint sealers are specified in Division 7 Section "Fire-stopping."

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
 - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
 - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply pre-molded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 - 2. Apply insulation to flanges as specified for flange insulation application.
 - 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 - 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 CELLULAR-GLASS INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply pre-molded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 2. Apply insulation to flanges as specified for flange insulation application.
 3. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same thickness as pipe insulation.
 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When pre-molded sections of insulation are not available, apply mitered sections of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without distributing insulation.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.7 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.8 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
1. Draw jacket material smooth and tight.
 2. Apply lap or joint strips with the same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.9 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Fire-suppression piping.
3. Drainage piping located in crawl spaces, unless otherwise indicated.
4. Below-grade piping, unless otherwise indicated.
5. Chrome-plated pipes and fittings, unless potential for personnel injury.
6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.

1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
2. Insulation Material: Mineral fiber
3. Insulation Thickness: 1" thick
4. Field-Applied Jacket: Foil and Paper(ASJ)
5. Vapor Retarder Required: No
6. Finish: None.

- 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" thickness
4. Field-Applied Jacket: Foil and Paper(ASJ)
5. Vapor Retarder Required: Yes.
6. Finish: None.

- C. Service: Condensate and equipment drain piping.

1. Operating Temperature: 40 to 60 deg F
2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
3. Insulation Thickness: 3/4"
4. Field-Applied Jacket: None.
5. Vapor Retarder Required: No.
6. Finish: Two coats of the insulation manufacturer's recommended protective coating.

- D. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F
2. Insulation Material: Pre-insulated piping, or Cellular glass, with jacket or Closed-cell phenolic foam.
3. Insulation Thickness, Cellular glass: Apply the following insulation thickness:
 - a. Steel Pipe, 1.5" and smaller: 1.5"
 - b. Steel Pipe, 2" to 12": 2"
4. Insulation Thickness, Closed-cell phenolic foam: Apply the following insulation thicknesses:
 - a. Steel Pipe, 1.5" and smaller: 1"
 - b. Steel Pipe, 2" to 4": 1.5"
 - c. Steel Pipe, 5" to 12": 2"
5. Field-Applied Jacket: PVC on exposed ceiling, Aluminum Jacket on all exterior,
6. Vapor Retarder Required: Yes.
7. Finish: None.

- E. Service: Refrigerant suction and hot-gas piping.
1. Operating Temperature: 35 to 50 deg F
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: None.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- F. Service: Domestic water piping.
1. Operating Temperature: 60 to 80 deg F
 2. Insulation Material: Mineral Fiber
 3. Insulation Thickness: 1" thick.
 4. Field-Applied Jacket: Foil and Paper(ASJ)
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- G. Service: For obtaining fire/smoke rating in return air plenum (cables, PE, PB, PP, ABS, PVC, CPVC, etc).
1. Operating Temperature: 35 to 90 deg F
 2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
 3. Insulation Thickness: larger of 1" or mfr's recommendations.
 4. Field-Applied Jacket: scrim reinforced foil
 5. Vapor Retarder Required: None.
 6. Finish: None.

3.11 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water.
1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses: 1"
 4. Field-Applied Jacket: Aluminum.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- B. Service: Refrigerant suction.
1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: Apply the following insulation thicknesses: ½"
 4. Field-Applied Jacket: Aluminum
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- C. Service: Chilled-water supply and return.
1. Operating Temperature: 35 to 75 deg F

2. Insulation Material: Pre-insulated piping, or Cellular glass, with jacket or Closed-cell phenolic foam.
3. Insulation Thickness, Cellular glass: Apply the following insulation thickness:
 - a. Steel Pipe, 1.5" and smaller: 1.5"
 - b. Steel Pipe, 2" to 12": 2"
4. Insulation Thickness, Closed-cell phenolic foam: Apply the following insulation thicknesses:
 - a. Steel Pipe, 1.5" and smaller: 1"
 - b. Steel Pipe, 2" to 4": 1.5"
 - c. Steel Pipe, 5" to 12": 2"
5. Field-Applied Jacket: Aluminum
6. Vapor Retarder Required: Yes.
7. Finish: None.

END OF SECTION

SECTION 15110
VALVES

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 general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Bronze check valves.
 - 3. Bronze gate valves.
 - 4. Cast-iron gate valves.
- B. Related Sections include the following:
 - 1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
 - 2. Division 13 fire-suppression piping and fire pump Sections for fire-protection valves.
 - 3. Division 15 Section "Mechanical Identification" for valve tags and charts.
 - 4. Division 15 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. SWP: Steam working pressure.
 - 6. TFE: Tetrafluoroethylene plastic.

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. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: , sanitary waste, and storm drainage piping valves unless referenced.

- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- 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 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
 - g. Watts Industries, Inc.; Water Products Div.

2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

- A. Copper-Alloy Ball Valves, General: MSS SP-110.
- B. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 400-psig (2760-kPa) minimum [600-psig (4140-kPa)] CWP rating.
- C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

2.4 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Type 1, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.
- C. Type 1, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

2.5 BRONZE GATE VALVES

- A. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- B. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

2.6 CAST-IRON GATE VALVES

- A. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
- B. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
- C. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.7 CAST-IRON PLUG VALVES

- A. Cast-Iron Plug Valves, General: MSS SP-78.
- B. Class 125 or 150, lubricated-type, cast-iron plug valves.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
 - 2. Throttling Service: Ball, butterfly, or globe valves.
 - 3. Pump Discharge: Swing check, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 400-psig (2760-kPa) CWP rating, copper alloy.
 2. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flanged, [150-psig (1035-kPa)] [175-psig (1207-kPa)] CWP rating, ferrous alloy, with EPDM liner.
 3. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: 175-psig (1207-kPa) CWP rating.
- D. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, [400-psig (2760-kPa)]CWP rating, copper alloy.
 2. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 150, ferrous alloy.
 3. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class [125] [150], bronze.
 4. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 125, gray iron.
 5. Gate Valves, NPS 2 (DN 50) and Smaller: Type [1] [2], Class 150] , bronze.
 6. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 125, bronze-mounted cast iron.
- E. Chilled Water Control Valves
1. Acceptable Manufacturers
 - a. Manufactured, brand labeled, or distributed by:
 - 1) BELIMO AIRCONTROLS (USA), INC.
 - 2) NEPTRONICS
 - 3) FLOW CONTROL INDUSTRIES
 2. Control Valves: factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
 3. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional (except as noted).
 4. Pressure independent control Valves
 - a. NPS 2 and Smaller: Forged brass body rated at no less than 360 PSI, stainless steel ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.
 - b. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.
 - c. Accuracy: The control valves shall accurately control the flow from 0 to 100% rated flow with an operating pressure differential range of 5 to 50 PSI differential across the valve with a valve body flow accuracy of +/- 5% total assembly.
 - d. Flow Characteristics Selectable: Equal percentage or linear flow.
 - e. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are not acceptable.
 - f. The manufacturer shall provide a published commissioning procedure following the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB).
 - g. A wet calibrated electronic flow meter shall provide dynamic feedback to measure flow and verify performance.
 - h. The control valve shall require no maintenance and shall not include replaceable cartridges.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

END OF SECTION

SECTION 15122
METERS AND GAGES

PART 1 - 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 meters and gages for mechanical systems and water meters installed outside the building.
- B. Related Sections include the following:
 - 1. Division 2 Section "Water Distribution" for water meters outside the building.
 - 2. Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment.

1.03 SUBMITTALS

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Liquid-in-Glass Thermometers:
 - a. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - b. Ernst Gage Co.
 - c. Marsh Bellofram.

- d. Palmer Instruments, Inc.
 - e. Terrice: H. O. Terrice Co.
 - f. Weiss Instruments, Inc.
 - g. Winter's Thermogauges, Inc.
- 2. Pressure Gages:
 - a. AMETEK, Inc.; U.S. Gauge Div.
 - b. Dresser Industries, Inc.; Instrument Div.; Ashcroft Commercial Sales Operation.
 - c. Dresser Industries, Inc.; Instrument Div.; Weksler Instruments Operating Unit.
 - d. Ernst Gage Co.
 - e. Marsh Bellofram.
 - f. Noshok, Inc.
 - g. Terrice: H. O. Terrice Co.
 - h. Weiss Instruments, Inc.
 - i. WIKA Instruments Corp.
 - j. Winter's Thermogauges, Inc.
- 3. Test Plugs:
 - a. Flow Design, Inc.
 - b. MG Piping Products Co.
 - c. National Meter.
 - d. Peterson Equipment Co., Inc.
 - e. Sisco Manufacturing Co.
 - f. Terrice: H. O. Terrice Co.
 - g. Watts Industries, Inc.; Water Products Div.

2.02 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:
 - 1. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (minus 18 to plus 38 deg C, with 1-degree scale divisions).
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.03 LIQUID-IN-GLASS THERMOMETERS

- A. Description: ASTM E 1.
- B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches (230 mm) long.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

- D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

2.04 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 - 1. Material: Stainless steel, for use in steel piping.
 - 2. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 - 3. Insertion Length: To extend to center of pipe.
 - 4. Cap: Threaded, with chain permanently fastened to socket.

2.05 PRESSURE GAGES

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Connector: Brass, NPS 1/4 (DN8).
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade B, plus or minus 2 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
 - 1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
 - 2. Fluids under Pressure: Two times the operating pressure.

2.06 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
- B. Syphons: NPS 1/4 (DN8) coil of brass tubing with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.07 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig (3450 kPa) minimum.
- D. Core Insert: Self-sealing valve, suitable for inserting 1/8-inch (3-mm) OD probe from dial-type thermometer or pressure gage.
- E. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- F. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
 - 1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.01 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
 - 1. Inlet and outlet of each hydronic zone. Refer to chilled water piping schematic/riser.
 - 2. Inlet and outlet of each hydronic chiller.
 - 3. Refer to plans for additional locations.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
 - 1. Install with socket extending to center of pipe.
 - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
 - 1. Install with stem extending to center of pipe.
 - 2. Fill wells with oil or graphite and secure caps.

3.03 PRESSURE-GAGE INSTALLATION

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Chilled-water inlets and outlets of chillers.
 - 3. Refer to plans for additional locations.
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
 - 1. Refer to plans for additional locations.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.
 - 1. Exception: Install syphon instead of snubber in piping to steam pressure gages.

3.04 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 15140
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Related Sections include the following:
 - 1. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.
- C. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Distribution Piping: 125 psig (860 kPa).

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

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 Components and Related Materials," for plastic, potable domestic water piping and components.
- C. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 COPPER TUBING

- A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
 - 4. Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - a. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

2.3 PVC PIPING

- A. PVC Schedule 40 Pipe:

2.4 VALVES

- A. Refer to Division 15 Section "Valves" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 15 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- 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 may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.

- D. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.
- E. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. NPS 1-1/2 (DN 40) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 2. NPS 2 (DN 50): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
 - 4. NPS 4 to NPS 6 (DN 100 to DN150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- F. Underground Domestic Water Piping NPS 4 (DN 100) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints. Water service larger than NPS 4 shall be PVC.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION

- A. Refer to Division 2 for site water distribution and service piping.
- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- C. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- D. Install underground copper tubing according to CDA's "Copper Tube Handbook."
- E. Install underground PVC piping according to ASTM D 2774 and ASTM F 645. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- G. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

- H. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Division 15 Section "Meters and Gages" for pressure gages, and to Division 15 Section "Plumbing Specialties" for drain valves and strainers.
- I. Install water-pressure regulators downstream from shutoff valves. Refer to Division 15 Section "Plumbing Specialties" for water-pressure regulators.
- J. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- K. Perform the following steps 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
- L. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. 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.

3.6 VALVE INSTALLATION

- A. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- B. 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. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

- c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) 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 15 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod
 - 2. NPS 1 and NPS-1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10mm) Rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13 mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13 mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- G. Install supports for vertical copper tubing every 10 feet (3m).

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 service piping with shutoff valve, and extend and connect to the following:
 - 1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
 - 3. 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 (DN 65) and larger.

3.9 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping 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 domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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.

3.10 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.**
1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 2. Adjust calibrated balancing valves to flows indicated.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:**
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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 (50 mg/L) 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 (200 mg/L) 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

SECTION 15150
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.
- B. Related Sections include the following:
 - 1. Division 15 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 - 1. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings: For solvent drainage system, include plans, elevations, sections, and details.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 PVC PIPING

- A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, and Vent Piping: Use the following piping materials for each size range:
 - 1. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. NPS 2 to NPS 4 (DN 50 to DN 100): PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. NPS 5 and NPS 6 (DN 125 and DN 150): Use NPS 6 (DN 150) PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, Soil, Waste, and Vent Piping: Use the following piping materials for each size range:
 - 1. NPS 2 to NPS 4 (DN 50 to DN 100): PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. NPS 5 and NPS 6 (DN 125 and DN 150): PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Refer to Division 2 Section "Sanitary Sewerage" for Project-site sanitary sewer piping.
- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
 - 1. Encase piping with PE film according to ASTM A 674 or AWWA C105.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- F. 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 $\frac{1}{4}$ 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 2 fixture 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.
- G. 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.
- H. Re-verify building drainage piping slope before covering pipe in trench if left uncovered over a 24 hour period of subjected to exterior water. If slope of piping has changed, provide new shoring material to maintain original slope after trench has been covered.
- I. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:
- J. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Cast-Iron, Sovent, Single Stack: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. 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 (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) 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 15 Section "Hangers and Supports."
- 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 (10-mm) minimum rods.
- J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 8 to NPS 12 (DN 200 to DN 300): (1200 mm) with 7/8-inch (22-mm) rod.
- K. Install supports for vertical PVC piping every 48 inches (1200 mm).
- L. 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. Refer to Division 15 Section "Plumbing Fixtures."
 - 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. Refer to Division 15 Section "Plumbing Specialties."
 - 4. 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 (DN 65) and larger.

3.7 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 (30 kPa). 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 (250 Pa). 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.

3.8 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.

END OF SECTION

SECTION 15181
HYDRONIC PIPING

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 piping, and hydronic specialties for chilled-water cooling; makeup water for these systems; blow-down drain lines; and condensate drain piping.
- B. Related Sections include the following:
 - 1. Division 7 Sections for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 7 Sections for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 4. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 5. Division 15 Section "Valves" for general-duty gate, globe, ball, butterfly, and check valves.
 - 6. Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
 - 7. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
 - 8. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
 - 9. Division 15 Section "HVAC Instrumentation and Controls" for temperature-control valves and sensors.

1.3 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Maintenance Data: For hydronic specialties to include in maintenance manuals specified in Division 1.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and

stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for fire-stopping specified in Division 7.

1.6 EXTRA MATERIALS

- A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for 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. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Central Sprinkler Company; Central Grooved Piping Products.
 - b. Grinnell Corporation.
 - c. Victaulic Company of America.
 - 2. Expansion Tanks:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - d. Taco, Inc.
 - 3. Air Separators and Air Purgers:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. ITT Bell & Gossett; ITT Fluid Technology Corp.

- d. Taco, Inc.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- F. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.
- C. Steel Pipe, NPS 14 through NPS 18 (DN 350 through DN 450): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 30, black steel, plain ends.
- D. Steel Pipe, NPS 20 (DN 500): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 20, black steel, plain ends.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 (DN 50) and smaller and electric-resistance welded for NPS 2-1/2 (DN 65) and larger.
- E. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- G. Malleable-Iron Unions: ASME B16.39; Classes 150.
- H. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Class 125; raised ground face, and bolt holes spot faced.
- I. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- J. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.

2. End Connections: Butt welding.
 3. Facings: Raised face.
- K. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
 - L. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - M. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
 - N. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 240 deg F (116 deg C) operating temperature; with NPS 1/4 (DN 8) discharge connection and NPS 1/2 (DN 15) inlet connection.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible [diaphragm] [bladder] securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- D. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger; threaded blow-down connection. Provide units in sizes for full-system flow capacity.
- E. In-Line Air Separators: One-piece cast iron with an integral weir designed to decelerate system flow to maximize air separation at a working pressure up to 175 psig (1206 kPa) and liquid temperature up to 300 deg F (149 deg C).
- F. Air Purgers: Cast-iron body with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal. Maximum working pressure of 150 psig (1035 kPa) and temperature of 250 deg F (121 deg C).
- G. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

- H. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- I. Basket Strainers: 125-psig (860-kPa) working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- J. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.
- K. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled Water, NPS 2 (DN 50) and Smaller: Aboveground, use Type L (Type B) drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints.
- B. Chilled Water, NPS 2-1/2 (DN 65) and Larger: Schedule 40 steel pipe with welded and flanged joints.
- C. Chilled Water Under-Ground Piping: Pre-Insulated Schedule 40 steel pipe with welded and flanged joints and HDPE jacket.
- D. Condensate Drain Lines: Type L (Type B) drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Gate, ball, and butterfly valves.
 - 2. Throttling Duty: Ball and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the top of the main pipe.
- G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blow-down connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2 (DN 50).
- H. Anchor piping for proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
 - 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
 - 6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
 - 7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
 - 8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
 - 9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

- 4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
- E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install automatic air vents in mechanical equipment rooms only at high points of system piping, and elsewhere as required for system air venting.
- B. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 (DN 50) and larger.
- C. Install combination air separator and strainer in pump suction lines. Install piping to compression tank with a 2 percent upward slope toward tank. Install blow-down piping with gate valve; extend to nearest drain.
- D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.
- E. Install expansion tanks. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with butterfly or ball valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to the following:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
6. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
7. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
8. Check expansion tanks to determine that they are not air bound and that system is full of water.
9. Subject piping system to hydrostatic test pressure that is 1.5 times the design pressure but not less than 100-psig (690-kPa). Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
10. After hydrostatic test pressure has been applied for at least 30 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

3.9 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
 1. Open valves to fully open position. Close coil bypass valves.
 2. Check pump for proper direction of rotation.
 3. Set automatic fill valves for required system pressure.
 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Check operation of automatic bypass valves.
 7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.

3.10 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

SECTION 15183
REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications.
- B. Related Sections include the following:
 - 1. Division 7 for roof curbs, piping supports, and roof penetration boots.
 - 2. Division 7 for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 3. Division 7 for materials and methods for sealing pipe penetrations through exterior walls.
 - 4. Division 15 Section "Hangers and Supports" for pipe supports and installation requirements.
 - 5. Division 15 Section "Mechanical Identification" for labeling and identifying refrigerant piping.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
- B. Shop Drawings: 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. Show interface and spatial relationship between piping and equipment.
 - 1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
- C. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- C. UL Standard: Provide products complying with UL standards.

1.5 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 for materials and methods for sealing pipe penetrations through fire and smoke barriers.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.

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-Dryer Cartridges: One of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Refrigerants:
 - a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Elf Atochem North America, Inc.; Fluorocarbon Div.
 - d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
 - 2. Refrigerant Valves and Specialties:
 - a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
 - b. Danfoss Electronics, Inc.
 - c. Emerson Electric Company; Alco Controls Div.
 - d. Henry Valve Company.
 - e. Sporlan Valve Company.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.
- B. Annealed-Temper Copper Tube: **ASTM B 88, Type K** (ASTM B 88M, Type A).
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.

- E. Bronze Filler Metals: AWS A5.8, Classification BAg-2 (silver)

2.3 VALVES

- A. Diaphragm Packless Valves: 500-psig (3450-kPa) working pressure and 275 deg F (135 deg C) working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.
- B. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- C. Solenoid Valves: Comply with ARI standards; 250 deg F (121 deg C) temperature rating and 400-psig (2760-kPa) working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch (16-GRC) conduit adapter and 24 V, normally open holding coil.
- D. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.
- E. Thermostatic Expansion Valves: Comply with ARI standards; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.4 REFRIGERANT PIPING SPECIALITIES

- A. Moisture/Liquid Indicators: 500-psig (3450-kPa) maximum working pressure and 200 deg F (93 deg C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- B. Permanent Filter-Dryer: 350-psig (2410-kPa) maximum operating pressure and 225 deg F (107 deg C) maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

2.5 REFRIGERANTS

- A. ASHRAE 34, R-22: Monochlorodifluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, within Building: Type ACR drawn-copper tubing.
- B. Belowground for NPS 2 (DN 50) and Smaller: Type K (Type A) annealed-copper tubing.

3.2 VALVE APPLICATIONS

- A. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.
- B. Install diaphragm packless valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- C. Install solenoid valves upstream from each expansion valve.
 - 1. Install solenoid valves in horizontal lines with coil at top.
 - 2. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.
- D. Install thermostatic expansion valves as close as possible to evaporator.
 - 1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
 - 2. Install valve so diaphragm case is warmer than bulb.
 - 3. 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.
 - 4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- E. Install pressure-regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

3.3 SPECIALTY APPLICATIONS

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves.
- C. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- D. Install pressure relief valves on ASME receivers; pipe discharge to outdoors.
- E. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.
- F. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.
- G. Install receivers, sized to accommodate pump-down charge, on systems **5 tons (17.5 kW)** and larger and on systems with long piping runs.
- H. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.4 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in protective conduit. Vent conduit outdoors.
- G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- H. 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.
- I. Install bypass around moisture-liquid indicators in lines larger than **NPS 2 (DN 50)**.
- J. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.
- K. When brazing, 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.
- L. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
- M. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than **20 feet (6.0 m)** long.
 - 2. Roller hangers and spring hangers for individual horizontal runs **20 feet (6.0 m)** or longer.
 - 3. Pipe rollers for multiple horizontal runs **20 feet (6.0 m)** or longer, supported by a trapeze.
- N. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. **NPS 1/2 (DN 15)**: Maximum span, **60 inches (1500 mm)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - 2. **NPS 5/8 (DN 18)**: Maximum span, **60 inches (1500 mm)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - 3. **NPS 1 (DN 25)**: Maximum span, **72 inches (1800 mm)**; minimum rod size, **1/4 inch (6.4 mm)**.
 - 4. **NPS 1-1/4 (DN 32)**: Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - 5. **NPS 1-1/2 (DN 40)**: Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
 - 6. **NPS 2 (DN 50)**: Maximum span, **96 inches (2400 mm)**; minimum rod size, **3/8 inch (9.5 mm)**.
- O. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

- A. Braze joints according to Division 15 Section "Basic Mechanical Materials and Methods."

- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.6 FIELD QUALITY CONTROL

- A. Test and inspect refrigerant piping according to ASME standards.
 - 1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
 - 2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
 - a. System shall maintain test pressure at the manifold gage throughout duration of test.
 - b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
 - c. Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Check compressor oil level above center of sight glass.
 - 2. Open refrigerant valves, except bypass valves that are used for other purposes.

3.8 CLEANING

- A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.9 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install filter-dryer but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 Pa). 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 (14 kPa).
 - 4. Charge system. Provide full-operating charge.

END OF SECTION

SECTION 15185
HYDRONIC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section governs the materials and installation of closed hydronic systems associated with building heating and cooling. The following systems, where applicable, shall be installed as specified herein.
 - 1. Chilled Water Cooling System

1.2 EQUIPMENT SUBSTITUTION

- A. Most items in this DIVISION are eligible for substitution in accordance with the General Conditions and Supplements thereto. Where a proprietary specification is written for a particular item, then only that item may be used. All items eligible for substitution require submission of request for substitution 10 days prior to bid date. This submittal shall include specific models and capacities of equipment and not just manufacturer's literature. Only those manufacturers listed and those receiving written prior approval communicated via addendum shall be considered for review. Verbal approvals will not be given.

1.3 TESTING & APPROVING AGENCIES

- A. Where items of equipment are required to be provided with compliance to U.L., A.G.A., or other testing and approving agencies, the contractor may submit a written certification from any nationally recognized testing agency, adequately equipped and competent to perform such services, that the item of equipment has been tested and conforms to the same method of test as the listed agency would conduct.

1.4 SUBMITTAL DATA

- A. See Section 01300 for general submittal requirements.
- B. Provide manufacturer's literature for all products specified in this Section, which will be installed under this project.
- C. Provide performance curves for all pumps. Plot the specified operating point for each pump on its respective curve.
- D. Provide complete literature for all components of packaged systems. These include pump performance, heat exchanger calculations, expansion tank capacity, data for all accessories and valves and complete wiring diagrams specific to the exact unit to be supplied. The wiring diagram shall indicate all required field and factory wiring.

PART 2 - PRODUCTS

2.1 PUMPS

- A. Acceptable Manufacturers:
 - 1. Taco

2. Bell & Gossett
3. Armstrong

B. Vertical Split Coupled Pumps.

1. Pumps shall be Taco Model KS or approved equal. The pumps shall be single stage end suction rear pull out design. The seal shall be serviceable without disturbing the piping connections. The capacities and characteristics shall be as called for in the plans/schedules.
2. Pump casing shall be constructed of ASTM A48 class 30 cast iron. The pump casing/volute shall be rated for 250 psi working pressure for all jobs. The pump flanges shall be matched to suit the working pressure of the piping components on the job, with either ANSI Class 125 flanges or ANSI class 250 flanges. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections and for a drain port at the bottom of the casing. The casing shall have an additional tapping on the discharge connection to allow for the installation of a seal flush line. The pump cover shall be drilled and tapped to accommodate a seal flush line which can be connected to the corresponding tapping on the discharge connection, or to an external source to facilitate cooling and flushing of the seal faces.
3. All casings shall be flanged. Threaded casings not allowed unless extra unions and fittings are provided with that pump to allow servicing.
4. The pump shall have a factory installed vent/flush line to insure removal of trapped air from the casing and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge.
5. The impeller shall be ASTM B584-836/875 bronze and hydraulically balanced. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted to the shaft with a key. The impeller shall be cast by the hydraulically efficient lost foam technique to ensure repeatability of high quality.
6. The pump shall be manufactured with AISI 416 Stainless Steel shaft.
7. The pump shall be fitted with a single mechanical seal, with EPT elastomers and Carbon/Ceramic faces, rated up to 250°F. This seal must be capable of being flushed externally via a tapping in the pump cover adjacent to the seal cavity. The entire pump line shall use no more than three different sizes of seals.
8. The pump shall be coupled via a high tensile aluminum split style coupling. The design must permit easy replacement of the mechanical shaft seal without removal of the motor. The motor mount must be designed to accept several different motor frame standards; CZ and HP.
9. In order to both simplify and reduce the total cost of ownership, the manufacturer shall standardize on no more than three sizes of mechanical seals through out the entire range of the family of pumps. The manufacturer shall not use multiple part numbers for the same part.

PART 3 - EXECUTION

3.1 PUMPS

A. GENERAL

1. All pumps shall be fitted with a discharge multi-purpose balancing valve or other means of providing system balance, isolation, and check feature for reverse flow. The valve shall be straight or angle pattern and shall be field convertible between the two. The valve shall be ductile iron and rated for 250 psi working pressure for all jobs. The valve flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The valve shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Valve shall be serviceable under full system pressure. The valve shall be a Taco model MPV Plus Two multi-purpose valve or equivalent.

2. All pump suction to be fitted with a multifunction inlet suction diffuser fitting equal to that as manufactured by Taco, Inc. The suction guide body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction. The fitting shall be a Taco model SD inlet suction elbow or equivalent.
3. All pumps shall be fitted with one 4 1/2" dial pressure gauge piped to the inlet and outlet pump flanges. The gauge is to be isolated from each flange via 1/4" ball valve. This gauge is to be used to take the differential across the pump unless otherwise indicated.
4. Contractor shall install pump in accordance with the manufacturer's instructions. Contractor shall level each pump.
5. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.
6. Pumps shall NOT be run dry to check rotation.
7. Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to nearest floor drain.

END OF SECTION

SECTION 15190
IDENTIFICATION AND PIPE MARKING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 15050, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.03 REFER TO ARCHITECTURAL SECTIONS FOR ADDITIONAL REQUIREMENTS.

PART 2 - PRODUCTS

2.01 VALVE AND PIPE IDENTIFICATION

- A. Valves:
 - 1. All valves shall be identified with a 1-1/2" diameter brass disc wired onto the handle. The disc shall be stamped with 1/2" high depressed black filled identifying numbers. These numbers shall be numerically sequenced for all valves on the job.
 - 2. The number and description indicating make, size, model number and service of each valve shall be listed in proper operational sequence, properly typewritten. Three copies to be turned over to Owner at completion.
 - 3. Tags shall be fastened with approved meter seal and 4 ply 0.018 smooth copper wire. Tags and fastenings shall be manufactured by the Seton Name Plate Company or approved equal.
 - 4. All valves shall be numbered serially with all valves of any one system and/or trade grouped together.
- B. Pipe Marking:
 - 1. All interior visible piping located in accessible spaces such as above accessible ceilings, equipment rooms, attic space, under floor spaces, etc., shall be identified with all temperature pipe markers as manufactured by W.H. Brady Company, 431 West Rock Ave., New Haven, Connecticut, or approved equal.
 - 2. All exterior visible piping shall be identified with UV and acid resistant outdoor grade acrylic plastic markers as manufactured by Set Mark distributed by Seton nameplate company. Factory location 20 Thompson Road, Branford, Connecticut, or approved equal.
 - 3. Generally, markers shall be located on each side of each partition, on each side of each tee, on each side of each valve and/or valve group, on each side of each piece of

equipment, and, for straight runs, at equally spaced intervals not to exceed 75 feet. In congested area, marks shall be placed on each pipe at the points where it enters and leaves the area and at the point of connection of each piece of equipment and automatic control valve. All markers shall have directional arrows.

4. Markers shall be installed after final painting of all piping and equipment and in such a manner that they are visible from the normal maintenance position. Manufacturer's installation instructions shall be closely followed.
5. Markers shall be colored as indicated below per ANSI/OSHA Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Sanitary Sewer	Green	Vent Sanitary Sewer
Storm Drain	Green	Storm Drain
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Recirculating	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply Condenser Water Return
Compressed Air	Blue	Compressed Air
Pneumatic Control	Yellow	Pneumatic Control
Oxygen	Yellow	Oxygen
Nitrogen	Green	Nitrogen
Deionized Water	Green	Deionized Water
Steam	Yellow	Steam Supply Steam Return

C. Pipe Painting:

1. All piping exposed to view shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections with Architect prior to installation.
2. to installation.
3. The entire fire protection piping system shall be painted red.
4. All piping located in mechanical rooms and exterior piping shall be painted as indicated below:

System	Color
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water Supply and Return	Reddish Orange

PART 3 - EXECUTION

- 3.01** All labeling equipment shall be installed as per manufacturers printed installation instructions.
- 3.02** All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Contractors price shall include all items required as per manufacturers' requirements.
- 3.03** All piping shall be cleaned of rust, dirt, oil and all other contaminants prior to painting. Install primer and a quality latex paint over all surfaces of pipe.

END OF SECTION

SECTION 15240
SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Vibration and sound control products.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division One specification sections, apply to work of this section
- B. This section is Division-15 Basic Materials and Methods section, and is part of each Division-15 section making reference to vibration control products specified herein.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.
- C. Except as otherwise indicated, sound and vibration control products shall be provided by a single manufacturer.

1.04 SUBMITTALS

- A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Amber/Booth Company, Inc.
- B. Mason Industries, Inc.
- C. Kenetics Noise Control.

2.02 GENERAL

- A. Provide vibration isolation supports for equipment, piping and ductwork, to prevent transmission of vibration and noise to the building structures that may cause discomfort to the occupants.
- B. Model numbers of Amber/Booth products are included for identification. Products of the additional manufacturers will be acceptable provided they comply with all of the requirements of this specification.

2.03 FLOOR MOUNTED AIR HANDLING UNITS

- A. Provide Amber/Booth XLW-2, style C aluminum housed isolators sized for 2" static deflection. Cast iron or steel housings may be used provided they are hot-dip galvanized after fabrication
- B. If floor mounted air handling units are furnished with internal vibration isolation option, provide 2" thick Amber/Booth type NRC ribbed neoprene pads to address high frequency breakout and afford additional unit elevation for condensate drains. Ribbed neoprene pads shall be located in accordance with the air handling unit manufacturer's recommendations.

2.04 SUSPENDED AIR HANDLING UNITS

- A. Provide Amber/Booth type BSWR-2 combination spring and rubber-in-shear isolation hanger sized for 2" static deflection.
- B. If suspended air handling units are furnished with internal vibration isolation option, furnish Amber/Booth type BRD rubber-in-shear or NR AMPAD 3/8" thick neoprene pad isolation hangers sized for approximately 1/2" deflection to address high frequency break-out.

2.05 SUSPENDED FANS AND FAN COIL UNITS

- A. Provide Amber/Booth type BSS spring hangers sized for 1" static deflection.

2.06 BASE MOUNTED PUMPS AND CHILLERS

- A. Amber/Booth type SP-NR style E flexplate pad isolators consisting of two layers of 3/8" thick alternate ribbed neoprene pad bonded to a 16 gage galvanized steel separator plate.
- B. Pads shall be sized for approximately 40 PSI loading and 1/8" deflection.

2.07 PIPING

- A. Provide spring and rubber-in-shear hangers, Amber/Booth type BSR in mechanical equipment rooms, for a minimum distance of 50 feet from isolated equipment for all chilled water and hot water piping 1-1/2" diameter and larger. Springs shall be sized for 1" deflection.
- B. Floor supported piping is required to be isolated with Amber/Booth type SW-1 open springs sized for 1" deflection.
- C. Furnish line size flexible connectors at supply and return of pumps, amber/booth style 2800 single sphere EPDM construction, connector shall include 150 lb. cadmium plated carbon steel floating flanges.

2.08 CORROSION PROTECTION

- A. All vibration isolators shall be designed and treated for resistance to corrosion.
- B. Steel components: PVC coated or phosphated and painted with industrial grade enamel. Nuts, bolts, and washers: zinc-electroplated.

PART 3 - EXECUTION

- 3.01** All equipment shall be installed in accordance with the manufacturers recommendations and printed installation instructions.
- 3.02** All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.
- 3.03** If internal isolation option is used on air handling units, the mechanical contractor shall verify proper adjustment and operation of isolators prior to start-up. All shipping brackets and temporary restraint devices shall be removed.
- 3.04** The vibration isolation supplier shall certify in writing that he has inspected the installation and that all external isolation materials and devices are installed correctly and functioning properly.

END OF SECTION

SECTION 15330
WET PIPE FIRE PROTECTION SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 15050, are included as a part of this Section as though written in full in this document.

1.02 SCOPE

- A. Scope of the work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.03 REGULATORY CODES

- A. Work in accordance with:
 - 1. NFPA.
 - 2. Local municipal codes that have jurisdiction.
- B. Products in accordance with:
 - 1. United Laboratories (UL) listed.
 - 2. Factory Mutual (FM) approved.

1.04 CERTIFICATE OF TESTING

- A. Furnish Owner with test certificate certifying the system approved by:
 - 1. City Fire Marshall.
 - 2. Insurance Services Officials (ISO)

PART 2 - PRODUCTS

2.01 FIRE SPRINKLER SYSTEM

- A. GENERAL:
 - 1. Work Included:
 - a. Design, coordination and installation of inside piping only, including sprinkler heads, valves, hangers and supports sleeves.
 - b. The sprinkler system is a wet type and is designed to provide coverage for the entire new building (ref. plans) The Contract Drawings indicate the extent and general arrangement, and the various occupancy classifications.
 - c. **Sprinkler heads shall be concealed type and brass uprights.**
 - d. The plans provide a preliminary layout with riser assembly location, flow switch locations, valve locations. These are a guide for subsequent preparation of the Contractor's detailed working drawings.
 - e. Interface system with fire alarm system.
 - 2. Quality Assurance: Equipment and installation to meet requirements of NFPA Number 13, latest edition and local authority having jurisdiction. All components of the completed system shall be UL listed for the intended service.

2.02 SUBMITTALS:

- A. Submit shop drawings in accordance with Section 15050.
- B. Submit preliminary layout showing only head locations for review by Architect/Engineer. Furnish additional heads which may be required for coordinated ceiling pattern without added cost, even though number of heads may exceed minimum code requirements.
- C. Submit shop drawings of entire sprinkler system including hydraulic calculations to Architect/Engineer.
- D. Provide Architect with Electronic PDF of final approved shop drawings before starting the installation. Include details of the sprinkler system showing sections, light fixtures, air conditioning, ducts, and a plan giving fire department connections, location of all exposed structures within twenty feet of this structure, and other equipment to be used. Drawings shall bear the stamp of review of the local fire insurance rating organization having jurisdiction.
- E. Service Utility Diagram: Furnish Architect with an accurately marked print showing location of underground pipes and valves as installed upon completion of underground Work.
- F. Provide a printed sheet giving brief instructions relative to all necessary aspects of sprinkler controls and emergency procedures next to sprinkler riser mains. Instruction sheet to be protected by glass or a transparent plastic cover.
- G. Materials:
 - 1. Above Ground Piping:
 - a. All piping above grade shall be:
 - schedule 10 black steel pipe with a rolled groove ends, joined with mechanical coupling and cut groove cast iron fittings for pipe 2-1/2" and greater.
 - schedule 40 black steel threaded pipe and fittings for pipe 2" and smaller.
 - b. Acceptable manufacturer:
 - American Tube
 - Wheatland Tube
 - Gem Sprinkler
 - All piping shall be by a domestic manufacturer.
 - c. Acceptable mechanical coupling manufacturer:
 - Victaulic
 - Grinnell
 - d. All fire main outlets to be welded:
 - NO Mechanical Tees will be allowed.
 - 2. Underground Ground Piping:
 - e. All piping below grade shall be:
 - C900 PVC / DR-14 with "FIRE LINE" warning ribbons 12 above pipe
 - Stainless Steel in-building rises
 - 3. Sprinkler Heads:
 - a. Suspended Ceiling Type: Concealed pendant type
 - b. Exposed Area Type: Standard upright type with brass finish
 - c. Sidewall Type: Chrome plated finish with matching escutcheon.
 - d. Temperature rating on fusible links to suit specific hazard area with minimum margin or safety 50 degrees F.
 - e. Sprinkler heads of the "O"-ring seal type are not acceptable.
 - f. .
 - g. Flexible type sprinkler head connection systems are not acceptable.
 - h. Acceptable manufacturer:

- Reliable
 - Grinnell
 - Viking
 - Tyco
4. Sprinkler Alarm Valve:
 - a. Provide approved automatic sprinkler valve with one or two pole (as required) flow detectors, pressure switch, outside electric gongs, and inside electric gong and circuit breaker.
 - b. Acceptable manufacturer:
 - Reliable
 - Grinnell
 - Viking
 - Tyco
 5. Valves:
 - a. 2" and smaller: bronze, rising stem, inside screw, solid wedge, U.L. listed valve.
 - b. 2-1/2" and larger: iron body, bronze trim, rising stem, OS&Y, solid wedge, U.L. listed valve.
 - c. Check valve: cast iron flanged body, bronze fitted, non-slam type.
 - d. Install valves with stems upright or horizontal, not inverted.
 - e. Acceptable manufacturer:
 - Nibco
 - Grinnell
 - Stockham
 - Victaulic
 6. Fire Department Connection:
 - a. Per Fire Departments requirements
 - b. 2.5" Siemese with Knox Caps

PART 3 - EXECUTION

3.01 All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

3.02 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items as required by NFPA and installed as per manufacturer's recommendations.

3.03 DESIGN

- A. Design spacing of sprinkler heads and selection sizes shall conform to the requirement of NFPA 13 for the indicated occupancy.
- B. Uniform discharge density design shall be based on hydraulic calculations utilizing the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform with NFPA 13.
- C. Friction losses in pipe will be based on a value of "C" =120 in the Hazen - Williams formula.
- D. Design and install the system so that no part will interfere with doors, windows, heating, plumbing, or electrical equipment. Do not locate sprinkler heads within 6 inches of lighting fixtures, HVAC diffusers and other obstructions. Sprinkler piping cannot penetrate ductwork or lighting fixtures.
- E. The Contractor shall conform to the National Fire Protection Association's Fire Code No. 13, latest edition. Special attention shall be given to Article 1-9, working plans. It shall be the Registered Fire Protection Engineer's responsibility to determine if any deficiency or deviations, such as an inadequate water supply, or any other item which would materially affect the acceptability of the system.

3.04 INSTALLATION

- A. Install all items in accordance with applicable codes.
- B. Install piping so that mains and branches are not located directly underneath HVAC equipment or other items needing access.
- C. All sprinkler heads shall be located as near the center of ceiling tiles as is practical ($\pm 1/2''$). Location shall present a uniform pattern with all heads aligned when completely installed.
- D. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads. Exact routing of piping shall be approved by Architect or relocated as required at no additional cost to Owner.
- E. Wire guards on all pendant or upright sprinkler heads in mechanical rooms, gymnasiums, athletic areas, wood and metal shops.
- F. Protect sprinkler heads against mechanical injury with standard guards.
- G. Locate outside alarms on wall of building adjacent to siamese fire department connection.
- H. Provide on wall near sprinkler valve, cabinet containing four extra sprinkler heads of each type and wrench suitable for each head type.
- I. Provide 1 inch diameter nipple and 1 inch x 1/2 inch reducing fitting for each upright head.
- J. Painting shall be as follows:
 - 1. Exposed sprinkler riser, alarm valve and all related piping shall be painted red.
 - 2. Exposed sprinkler piping in finished areas shall be painted as directed by Architect.

3.05 REPLACEMENT

Upon receipt of written notice of failure of any part of the guaranteed equipment during the guaranteed period, the Contractor will replace the affected part or parts promptly at no additional cost.

3.06 TESTING

- A. Prior to testing, the entire sprinkler system shall be thoroughly flushed clean.
- B. Upon completion of the installation and flushing, test the system and obtain approval of the local fire insurance rating organization having jurisdiction. Particular attention is called to the requirements of NFPA 13 pamphlet.

3.07 TRAINING

- A. Owner's people shall be fully briefed in the normal start-up of the system, operation, normal and emergency shutdown, and maintenance of the system.
- B. Routine maintenance, yearly maintenance, winterization, and spring start-up shall be fully discussed and documented.
- C. Names of those instructed and dates, as well as a list of information handed over to the owner, shall be included in the final report.

END OF SECTION

SECTION 15410
PLUMBING FIXTURES

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 plumbing fixtures and related components.
- B. Related Sections include the following:
 - 1. Division 15 Section "Drinking Fountains and Water Coolers."
 - 2. Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of 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.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

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. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.

2.2 LAVATORY FAUCETS

- A. Lavatory Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Products:
 - a. American Standard.
 - b. Eljer.
 - c. Kohler.

2.3 SHOWER FAUCETS

- A. Shower Faucet: Include hot- and cold-water indicators; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
 - 1. Manufacturers:
 - a. American Standard.
 - b. Eljber.
 - c. Kohler.

2.4 SINK FAUCETS

- A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Manufacturers:
 - a. American Standard.
 - b. Eljer
 - c. Kohler.

2.5 TOILET SEATS

- A. Toilet Seat: Solid plastic.
 - 1. Manufacturers:
 - a. Bemis.
 - b. Beneke.
 - c. Centoco.
 - d. Church.

2.6 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Guard, Manufactured, plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.
 - 1. Manufacturers:
 - a. Engineered Brass Co.
 - b. Plumerex
 - c. Truebro.

2.7 FIXTURE SUPPORTS

- A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 - 1. Manufacturers:
 - a. Mifab
 - b. Josam.
 - c. Wade.
 - d. Zurn
- B. Urinal Support: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. J.R. Smith
 - c. Zurn.
 - 2. Accessible Fixture Support: Include rectangular steel uprights.
- C. Lavatory Support: Type II, lavatory carrier with concealed arms and tie rod. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. J.R. Smith
 - c. Zurn.
 - 2. Accessible Fixture Support: Include rectangular steel uprights.

- D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. J.R. Smith
 - c. Zurn.

2.8 WATER CLOSETS

- A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. TOTO USA, Inc.
- B. Water Closets: Accessible, floor mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. TOTO USA, Inc.

2.9 URINALS

- A. Urinals,: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. TOTO USA, Inc.

2.10 LAVATORIES, SINKS

- A. Lavatories,: Accessible, wall hanging, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Toto

2.11 KITCHEN SINKS

- A. Kitchen Sinks: Commercial, counter-mounting, stainless-steel fixture.
 - 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.

2.12 SERVICE SINKS

- A. Service Sinks: Floor-mounting, enameled, sink with front apron, raised back, and coated, wire rim guard.
 - 1. Products:
 - a. Commercial Enameling Co.
 - b. Kohler Co.
 - c. Fiat

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging 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-hanging 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 manufacturers' written instructions and 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 valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- 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 and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install toilet seats on water closets.
- N. 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.
- O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. 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.
- Q. Install traps on fixture outlets.
- R. 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. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- 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.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed 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.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

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.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 15415
DRINKING FOUNTAINS AND WATER COOLERS

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. Drinking fountains.
 - 2. Self-contained water coolers.
 - 3. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain and Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler, unless one is specifically indicated.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For fixtures to include in maintenance manuals specified in Division 1.

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" about 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 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.
- E. TAS: Texas Accessibility Standards.

1.6 COORDINATION

- A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified below.
 - 1. Elkay.
 - 2. Halsey Taylor.
 - 3. Haws Corporation.

2.2 DRINKING FOUNTAINS

- A. Drinking Fountains,: Accessible, Style W, wall-hanging fixture made of stainless steel.
 - 1. Receptor Shape: Rectangular.
 - 2. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 3. Bubblers: Two, with automatic stream regulator, located on deck.
 - 4. Control: Push button.
 - 5. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
 - 6. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 - 7. Support: Type I, water-cooler carrier. Refer to "Fixture Supports" Article.

2.3 SELF-CONTAINED WATER COOLERS

- A. Water Coolers: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-hanging fixture.
 - 1. Cabinet: Bilevel with two attached cabinets, enameled steel with stainless-steel top.
 - 2. Bubbler: One, with automatic stream regulator, located on each cabinet deck.
 - 3. Control: Push button.
 - 4. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve and filter.

5. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
 - b. Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
7. Support: Type II, water-cooler carrier. Refer to "Fixture Supports" Article.

2.4 FIXTURE SUPPORTS

- A. Off-Floor, Plumbing Fixture Supports: 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. Available Manufacturers:
 2. Manufacturers:
 - a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Specifications Drainage Operation.
 3. Type I: Hanger-type carrier with two vertical uprights.
 4. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 5. 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 and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Refer to Division 15 Section "Valves" for general-duty valves.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 for sealant and installation requirements.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. 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.

END OF SECTION

SECTION 15430
PLUMBING SPECIALTIES

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 plumbing specialties:
 - 1. Balancing valves.
 - 2. Washer-supply outlets.
 - 3. Key-operation hydrants.
 - 4. Trap seal primer valves.
 - 5. Drain valves.
 - 6. Miscellaneous piping specialties.
 - 7. Sleeve penetration systems.
 - 8. Flashing materials.
 - 9. Cleanouts.
 - 10. Floor drains.
 - 11. Roof drains.
 - 12. Grease interceptors.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Piping: 125 psig (860 kPa).
 - 2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).
 - 3. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - 1. Balancing valves.

2. Water hammer arresters, and trap seal primer valves and systems.
 3. Hose bibbs, hydrants.
 4. Washer-supply outlets.
 5. Cleanouts, floor drains, and roof drains.
 6. Roof flashing assemblies.
 7. Grease interceptors.
 8. Sleeve penetration systems.
- B. Shop Drawings: Diagram power, signal, and control wiring.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- E. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
 2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
1. Manufacturers:
 - a. Armstrong Pumps, Inc.
 - b. Flow Design, Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. Taco, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. NPS 2 (DN 50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 3. NPS 2 (DN 50) and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 4. NPS 2-1/2 (DN 65) and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.

- B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- 1. Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. Crane Co., Crane Valve Group; Crane Valves.
 - c. Grinnell Corporation.
 - d. NIBCO INC.
 - e. Red-White Valve Corp.

2.2 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
 - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.

2.3 OUTLET BOXES

- A. Manufacturers:
 - 1. Acorn Engineering Company.
 - 2. Gray, Guy Manufacturing Co., Inc.
 - 3. Symmons Industries, Inc.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Clothes Washer Outlet Boxes: With hot- and cold-water hose connections, drain, and the following:
 - 1. Box and Faceplate: [Stainless steel] [Enameled or epoxy-painted steel].
 - 2. Shutoff Fitting: Two hose bibbs.
 - 3. Supply Fittings: Two NPS 1/2 (DN 15) gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
 - 4. Drain: NPS 2 (DN 50) standpipe, P-trap, and direct waste connection to drainage piping.
 - 5. Inlet Hoses: Two ASTM D 3571, 60-inch- (1500-mm-) long, rubber household clothes washer inlet hoses with female hose-thread couplings.
 - 6. Drain Hose: One 48-inch- (1200-mm-) long, rubber household clothes washer drain hose with hooked end.
- D. Icemaker Outlet Boxes: With hose connection and the following:
 - 1. Box and Faceplate: Stainless steel.
 - 2. Shutoff Fitting: Hose bibb.

3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.4 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 1. Josam Co.
 2. Smith, Jay R. Mfg. Co.
 3. Woodford Manufacturing Co.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig (860 kPa).
 1. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25) threaded or solder joint.
 2. Outlet: ASME B1.20.7, garden-hose threads.
 3. Operating Keys: One with each key-operation hydrant.
- C. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, and concealed outlet.
 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
- D. Hot and Cold, Nonfreeze Concealed-Outlet Wall Hydrants: With deep flush-mounting box with cover; hot- and cold-water casings and operating rods to match wall thickness; concealed outlet; wall clamps; and factory- or field-installed, nonremovable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.

2.5 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
 1. Manufacturers:
 - a. Josam Co.
 - b. MIFAB Manufacturing, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Smith, Jay R. Mfg. Co.
 2. 125-psig (860-kPa) minimum working pressure.
 3. Bronze body with atmospheric-vented drain chamber.
 4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.6 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
 1. Manufacturers:

- a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Industries, Inc.; Specification Drainage Operation.
- B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
- C. Roof Flashing Assemblies: Manufactured assembly made of [4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6-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)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
- D. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- E. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- F. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- G. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- H. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- I. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.7 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. 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.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.8 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-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-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. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.9 CLEANOUTS

- A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.
 - 1. Application: [Floor cleanout] [Wall cleanout] [For installation in exposed piping].
 - 2. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc., Specification Drainage Operation.

2.10 FLOOR DRAINS

- A. Floor Drains.
 - 1. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc.

2.11 ROOF DRAINS

- A. Roof Drains: Comply with [ASME A112.21.2M] [ASME A112.3.1].
 - 1. Application: Roof drain.
 - 2. Products:
 - a. Josam Co.

- b. Mifab
- c. Smith, Jay R. Mfg. Co.
- d. Tyler Pipe, Wade Div.
- e. Watts Industries, Inc., Drainage Products Div.
- f. Zurn Industries, Inc.

2.12 GREASE INTERCEPTORS

- A. Grease Interceptors: Comply with PDI-G101.
 - 1. Products:
 - a. American Industrial Precast Products, Inc.
 - b. Brooks Products
 - c. Park Equipment Co.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- C. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- D. Install 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.
- E. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- F. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- G. 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.
- H. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- I. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

- J. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- K. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- L. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- M. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. 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.
- N. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- O. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with In-Ground Installation: Set unit and extension, if required, with cover flush with finished grade.
 - 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- P. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- Q. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- R. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- S. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
- T. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 15 Sections.
- D. Ground equipment.
- E. 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.
- F. Connect plumbing specialties and devices that require power according to Division 16 Sections.
- G. Interceptor Connections: Connect piping, flow-control fittings, and accessories.
 - 1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping.

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-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- 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 Division 7 Section "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.

3.4 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 - 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. Remove malfunctioning units, replace with new units, and retest.
 - 3. **Test and adjust controls and safeties.** Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15485
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for domestic water systems:
 - 1. Tankless, electric water heaters.
 - 2. Commercial, electric water heaters.
 - 3. Compression tanks.
 - 4. Accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
- D. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
 2. ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings," for household water heaters.

1.5 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Point-of-Use, Tankless, Electric Water Heaters:
 - a. Chronomite Laboratories, Inc.
 - b. Eemax
 2. Commercial, Point-of-Use, Storage, Electric Water Heaters:
 - a. Rheem
 - b. State Industries.
 3. Commercial, Storage, Electric Water Heaters:
 - a. OA Smith
 - b. Bradfrom
 - c. PVI Industries, Inc.
 - d. State Industries.
 4. Water Heater Stand and Drain Pan Units:
 - a. Safety: W. H. Safety Products, Inc.
 5. Compression Tanks:
 - a. Bell & Gossett
 - b. Taco, Inc.
 - c. Zurn Industries, Inc.; Wilkins Div.

2.2 POINT-OF-USE, TANKLESS, ELECTRIC WATER HEATERS

- A. Description: Comply with UL 499.
- B. Construction: Without hot-water storage.

1. Working-Pressure Rating: 150 psig (1035 kPa).
2. Tappings: ASME B1.20.1, pipe thread.
3. Interior Finish: Materials complying with NSF 61, barrier materials for potable-water tank linings.
4. Jacket: Aluminum or steel, with enameled finish, or plastic.

C. Heating System: Electric-resistance type.

1. Temperature Control: Adjustable thermostat.
2. Safety Control: Automatic, high-temperature-limit cutoff device or system.

D. Mounting: Bracket or device for wall mounting.

2.3 **COMMERCIAL, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS (6 TO 40 GALLON)**

A. Description: Comply with UL 174 or UL 1453, and listed by manufacturer for commercial applications.

B. Storage Tank Construction: Non-ASME-code steel with 150-psig (1035-kPa) working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
2. 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.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

C. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.

1. Temperature Control: Adjustable thermostat.

D. Anode Rod: Factory installed, magnesium.

E. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

F. Special Requirement: NSF 5 construction.

2.4 **COMMERCIAL, STORAGE, ELECTRIC WATER HEATERS (OVER 40 GALLONS)**

A. Description: Comply with UL 1453.

B. Storage Tank Construction: ASME-code steel with 150-psig (1035-kPa) working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 (DN50) and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
2. 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.

- 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 - 4. Jacket: Steel, with enameled finish.
- C. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of three.
 - 1. Exception: Water heaters up to 9-kW input may have 2 or 3 elements.
 - 2. Staging: Input not exceeding 18 kW per step.
 - 3. Temperature Control: Adjustable surface-mounted thermostat.
 - 4. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- D. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- E. **Water inlet and outlet connections shall be BRASS.**
- F. Anode Rods: Factory installed, magnesium.
- G. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.
- H. Special Requirement: NSF 5 construction.

2.5 COMPRESSION TANKS

- A. 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.
- B. Construction: 150-psig (1035-kPa) working-pressure rating.
- C. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- D. Tank 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.
- E. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.
- F. Air-Charging Valve: Factory installed.

2.6 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
- B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.
 - 1. Exception: Omit if water heater has integral vacuum-relieving device.
- C. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

- D. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
- E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN20).

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated. Refer to Division 3 and Division 15 Section "Basic Mechanical Materials and Methods."

3.2 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install 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.
- C. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- D. Install vacuum relief valves in cold-water-inlet piping.
- E. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for drain valves.
- F. Install thermometers on water heater inlet and outlet piping
 - 1. Exception: Omit thermometers for the following:
 - a. Commercial, point-of-use, water heater inlet piping.
 - b. Water heater with thermometer outlet piping.
- G. Fill water heaters with water.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- 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 Standards.

3.4 FIELD QUALITY CONTROL

- A. In addition to manufacturer's written installation and startup checks, perform the following:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 2. Verify that piping system tests are complete.
 - 3. Check for piping connection leaks.
 - 4. Check for clear relief valve inlets, outlets, and drain piping.
 - 5. Check operation of circulators.
 - 6. Test operation of safety controls, relief valves, and devices.
 - 7. Energize electric circuits.
 - 8. Adjust operating controls.
 - 9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F (60 deg C) unless piping system application requires higher temperature.
 - 10. Balance water flow through manifolds of multiple-unit installations.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
 - 1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals. Refer to Division 1.
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 15488
VARIABLE FREQUENCY DRIVES

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 solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections include the following:
 - 1. Division 16 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
 - 2. Division 16 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.

1.3 DEFINITIONS

- A. BAS: Building Automation System.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFD: Variable frequency drive.

1.4 REFERENCES

- A. ANSI/NEMA ICS 6 – Enclosures for industrial control systems.
- B. ANSI/UL 198C – High intensity capacity fuses; current limiting types.
- C. NEMA ICS 2 – Industrial control devices, controllers, and assemblies.
- D. NEMA KS 1 – Enclosed switches.
- E. NEMA PB 1.1 – Instructions for safe installation, operation, and maintenance of panelboards rated 600 volts or less.

1.5 SUBMITTALS

- A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFD.
 - 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. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current ratings of integrated unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.
- C. Manufacturer's field service report.
- D. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals. Include routine maintenance requirements for VFDs and all installed components

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.
- D. Comply with NFPA 70.
- E. UL listed drive and UL-508 listed bypass/inverter assembly.

1.7 WARRANTY

- A. Written warranty, signed by manufacturer. Manufacturer's standard form in which manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period. Manufacturer will provide all labor required for replacement of materials, equipment, controls, and any other portion of complete assembly, as required. A factory-trained employee of manufacturer shall perform warranty work.
 1. Warranty Period for VFD's: five years from date of Substantial Completion.
 2. Warranty period will commence from the date of manufacturer's startup.
- B. For the duration of the warranty, local manufacturer's representative must provide a response time of no more than 24 hours. Any failed VFD must be put back into automatic operation within this time period. Mere acknowledgement of a problem does not constitute an acceptable response.

1.8 SPARE PARTS

- A. Spare Fuses: Furnish three spare fuses for each type and rating installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss – Basis of Design
 - b. Yaskawa
 - c. ABB

d. Franklin Controls

- B. Specific models proposed must have a continuous and proven track record of no less than two years.

2.2 VARIABLE FREQUENCY DRIVES

- A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
1. Input ac voltage tolerance of 380 to 480 V, plus or minus 10 percent.
 2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.
 3. Capable of driving full load, under the following conditions, without derating:
 - a. Ambient Temperature: 0 to 40 deg C.
 - b. Humidity: Less than 90 percent (non-condensing).
 - c. Altitude: 3300 feet (1000 m).
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 97 percent.
 6. Overload Capability: 1.10 times the base load current for 60 seconds at 40°C; 2.0 times the base load current for 3 seconds at 40°C.
 7. Starting Torque: 100 percent of rated torque or as indicated.
 8. Speed Regulation: Plus or minus 1 percent.
 9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
 10. Continuous output current rating shall be no less than 100% of NEC motor amperage ratings.
 11. Overload current capability of power cube at 40°C shall equal or exceed 200% of NEC motor amperage values for instantaneous trip, and 110% of NEC amperage for a minimum of sixty seconds, without damage to power cube.
 12. Minimum 4% input impedance line reactor; comply with EN61000-3-2.
 13. Minimum 3% DC link reactor (also called inductive choke) connected to the DC bus between the rectifier and the PWM inverter.
- E. Power Quality Issues
1. VFD must be capable of operating satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic distortion and commutation notches up to 36,500 volt-microseconds, and when other VFDs are operating from the same bus.
 2. VFD shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (the consumer-utility interface or primary side of the main distribution transformer).
 3. The system shall not produce spikes on the incoming line.
 4. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.
 5. Provide input line noise suppression with MOV's (metal oxide varistors) and snubber circuits to allow

for operation on typical industrial or commercial power distribution systems. MOV's shall be provided across incoming line terminals and transistors to protect inverter from voltage surges and spikes.

6. The VFD shall not induce excessive power losses in motors. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS current for pure sine wave operation.
7. VFD must be capable of operating a motor satisfactorily with up to 300 feet of wiring between VFD and motor.

F. Diodes: Bridge rated for 1600 volts.

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Snubber networks to protect against malfunction due to system voltage transients.
3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
4. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor overload.
11. Motor over-temperature fault.
12. Heat sink over temperature (Max. operating ambient: 104 degrees F)
13. Protect solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent over-current trip due to momentary overload conditions.

I. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto-speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

K. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

- N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- P. Control Signal Interface: Provide VFD with the following:
1. Provide communications devices as necessary to allow for connectivity to major automation systems.
 2. VFD shall be provided with protocol information specific to Owner's BAS control manufacturer and shall be pre-configured at the factory to provide automatic communications, without the need for field programming, via a single twisted pair wire.
 - a. The VFD shall allow the DDC system to control the drive's digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
 - b. VFD is to support BACNet, LonWorks, and Modbus RTU.
 - c. Serial communications capabilities include, but are not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and acceleration/deceleration time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.
 3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.
 4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (over-temperature or over-current).
 - d. PID high or low speed limits reached.
- Q. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

- R. Isolating Switch: Non-load-break switch arranged to isolate VFD and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- S. Bypass Controller:
 - 1. NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
 - 2. Bypass section is to be located in a metal enclosure separate from the drive section, and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode without exposing personnel to any electrical voltage. VFD shall have inverter input power disconnect with door interlocked handle (lock out type) arranged to isolate VFD and permit safe troubleshooting & testing of inverter in when energized and/or de-energized, while motor is operating in bypass mode.
 - 3. Manual bypass shall contain:
 - a. A molded case circuit breaker or non-fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
 - b. A thermal overload to provide protection of motor in the bypass mode.
 - c. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation—"inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
 - d. Line voltage to 120/1 volt transformers, fused per NEC, to provide power to bypass control circuits. Transformer shall be sized to include additional 20 va capacity for use by EMS contractor. DC and/or solid-state bypass sources are not acceptable.
- T. Non-fused input disconnect switch.

2.3 ENCLOSURES

- A. NEMA 1, for VFDs in conditioned space.
- B. Metal inverter enclosure. Plastic and/or fiberglass enclosures are not acceptable.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFDs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.
- B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.
- B. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."
- C. Do not install incoming AC lines in same conduit as feeder lines to motor.
- D. Do not install wiring runs between VFD and motor longer than recommended by manufacturer.

3.4 IDENTIFICATION

- A. Identify VFDs, components, and control wiring according to Division 16 Section "Basic Electrical Materials and Methods"

3.5 CONNECTIONS

- A. Ground equipment.
- B. 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.

3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality-control testing:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFDs, and perform startup service.
- B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.
- C. Complete installation and startup checks according to manufacturer's written instructions.
- D. Upon successful completion of testing, submit written certification that drives are operating in accordance with Contract Documents, and within design operating limits of equipment. Notify Owner/Owner's representative; include set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

- A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 DEMONSTRATION

- A. Provide services of manufacturer trained employee(s) for instructing Owner on operation and maintenance. Provide minimum of three hours training.
 - 1. Demonstrate operation of controllers in the automatic, manual, and bypass modes.

END OF SECTION

SECTION 15545
CHILLED AND HOT WATER TREATMENT SYSTYEMS

PART 1 – GENERAL
GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Basic Materials and Methods, Section 15050, are included as a part of this Section as though written in this document.

SCOPE

Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

DESCRIPTION OF WORK

- C. Work Included: Perform water analysis and provide all water treatment products and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified herein after as follows – ALL existing chemical equipment shall be re-used:
 - 1. Chilled Water System.
- D. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for one (1) year after acceptance by Owner.
- E. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- F. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three (3) months after acceptance by the Owner. ALL EXISTING CHEMICAL EQUIPMENT SHALL BE RE-USED.
- G. Service Representative:
 - 1. Cleaning and Flushing test required verifying satisfactory completion of clean pipe.
 - 2. Provide water analysis report quarterly on each operating system.
 - 3. Annually perform microbiological culture study on the system to monitor bacteria.

QUALITY ASSURANCE

- H. Qualifications: The Water Treatment Contractor for work under this Section shall have:
1. Research and development facilities.
 2. Regional laboratories capable of making a water analysis.
 3. A service department and qualified technical service representative located within a reasonable distance of the project site.
 4. Service representatives who are Registered Engineers or factory- certified technicians with not less than five (5) years of water treatment experience with the water treatment system manufacturer.
- I. Packaging and Labeling: Water treatment chemicals will be supplied in a container suitable for product, and will be in accordance with DOT shipping standards.
- J. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.
- K. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

SUBMITTALS

- L. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test. Tests will included by are not limited to conductivity, pH, chemical residual, iron, copper, and bacteria count.
- M. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, pumps, piping and tubing sizes, fittings, accessories, valves and connections and monitoring equipment.
- N. Guarantee: Submit written guarantee, signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required to achieve the required performance, during a one (1) year period following the final start-up or the continued operation of the systems.
- O. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four (4) copies of an "Agreement for Continued Service and the Owner's Possible Acceptance." Offer terms and conditions for furnishing chemical and providing continued testing and equipment for a one (1) year period with option for renewal of the Agreement by Owner.

PART 2 – PRODUCTS

GENERAL

- A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.
- B. Pre-Treatment: Treat water piping systems with chemicals to remove and permit flushing of mill scale, oil, grease and other foreign matter.
- C. FDA and USDA Approval: Use only FDA and USDA approved products in system with direct connection to domestic water systems.
- D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

APPROVED WATER TREATMENT SERVICE

- E. Nalco
- F. Garratt Callahan

CHILLED AND HOT WATER SYSTEMS

- G. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
 - 1. Form a protective film to prevent corrosion and scale formation;
 - 2. Scavenge oxygen and protect against scale;
 - 3. Remain stable throughout operating temperature range, and;
 - 4. Are compatible with pump seals and other elements in the system.
 - 5. The inhibitor shall be a borate-nitrate corrosion inhibitor compound at 400 – 800 ppm; or for aluminum condensing boiler molybdate at 10 to 25 ppm.
- H. Equipment: For each system, provide a 5-gallon filter feeder constructed of materials which are impervious to the products dispensed. Feeder shall be designed for not less than 200-psig operating pressure. Filter feeder shall be as manufactured by Vector Industries model FA-900 or approved equal. Provide flow indicator meter on discharge of filter feeder.
- I. Test Kit: Provide test kit and reagents for determining proper water conditions.
- J. Treatment: Treat initial water charge to water system, after system has been flushed and prepped, to achieve a water quality as specified. Test report required to verify cleaning.
- K. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:
 - 1. D1067 – Tests for Acidity or Alkalinity of Water.
 - 2. D1068 – Tests for Iron in Water and Waste Water.
 - 3. D1126 – Tests for Hardness in Water.
 - 4. D1128 – Identification of Types of Microorganisms and Microscopic Matter in Water and Waste Water.
 - 5. D3370 – Sampling Water.

PART 3 – EXECUTION

3.1 THE WATER TREATMENT CONTRACTOR

- A. General: After piping systems are erected pressure tested and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work. Flushing must be for a minimum of 24 continuous hours.
- B. Testing: After completion of 24 continuous hours of flushing, perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

PART 4 – MECHANICAL CONTRACTOR

4.1 SERVICES OF MECHANICAL CONTRACTOR

- A. Piping systems shall be pressure tested and approved for tightness; they shall be thoroughly cleaned and flushed using and approved pipe cleaning.
- B. After initial chemical treatment has been added, the systems must be circulated for 48 hours with all valves opened; then the automated building system can be initiated.

4.2 PIPE CLEANING, STERILIZATION, AND FLUSHING

- A. Additions/Renovations: When connecting existing lines to newly installed lines, provide wire strainer with fine mesh screens.
- B. All connections required for cleaning, purging and circulating shall be included as permanent installation with valves. Provide permanent pipe bypasses at each coil and heat exchanger during this cleaning operation and for future flushing. All air vents, gauges, strainers, etc., valved connections in piping systems shall be blown clean during and after cleaning operation is completed and during.
- C. After cleaning, drain the system, fill with fresh water and flush thoroughly for a minimum of 24 hours on a system that is not greater than 3,000 gallons. Systems greater than 3,000 gallons should be flushed thoroughly for a minimum of 48 hours or as recommended by Engineer.
- D. All flushing, cleaning, and initial chemical treatment shall be complete and witnessed by Owner prior to starting systems.
- E. Start-up procedures: During water system start-up, operate water treating system (after changing with specified chemicals) to maintain the required steady-state characteristics of water. Demonstrate system operation to Owner's operating personnel.

PART 5 – ADDITIONAL REQUIREMENT FOR THE WATER TREATMENT CONTRACTOR

5.1 Vendor shall warrant the chemicals used in the water treatment program, and will have no detrimental effects on the metallic or non-metallic materials in the equipment being treated; if applied according to Vendor's instructions.

- A. All testing of the Owner's systems are to be completed on-site and discussed with Owner's HVAC personnel with a copy of the report given to him/her for signature.
- B. All work shall be performed in cooperation with Owner's HVAC personnel.
- C. Periodic de-scaling with inhibited acids will not be considered as meeting this specification.
- D. Sulfuric acid or other inhibited acids shall not be used in the chemical treatment program of Owner.
- E. The Contractor shall provide a biocide program consisting of both an oxidizing biocide and bio-dispersant if required.

5.2 PERSONNEL TRAINING

- A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.
- B. Provide two (2) hours in use and operation of water treating systems including preparation of chemical solution reservoir.

END OF SECTION

SECTION 15800
CHILLED WATER AIR HANDLING UNITS

PART 1 — GENERAL

1.01 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum of 5 years documented experience.
- B. Units shall be manufactured in a facility registered to ISO 9001 manufacturing quality standard.
- C. Air-handling unit assembly shall have UL 1995 certification for safety, including use with electric heat.
- D. Products requiring electric connection shall be listed and classified by ETL and CSA as suitable for the purpose specified and indicated.
- E. Coil performance shall be certified in accordance with AHRI Standard 410, latest edition.
- F. Unit performance shall be rated in accordance with AHRI Standard 430 for Central Air Handling Units and subject to verification of rating accuracy by AHRI-sponsored, third party testing. Units shall meet NFPA 90A requirements.

1.02 SUBMITTALS

A. Product Data: For each type of modular outdoor air-handling unit indicated. Include the following:

- 1. Certified fan-performance curves with system operating conditions indicated.
- 2. Certified fan-sound power ratings.
- 3. Certified coil-performance ratings with system operating conditions indicated.
- 4. Motor ratings, electrical characteristics, and motor and fan accessories.
- 5. Material gages and finishes.
- 6. Filters with performance characteristics.
- 7. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

- 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field Quality-Control Test Reports: From manufacturer.

1.03 DELIVERY, STORAGE AND PROTECTION

- A. All outdoor units shall be completely shrink-wrapped from the factory for protection during shipment. Tarping of bare units is unacceptable.
- B. Inspect for transportation damage and store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

Units shall ship in the number of sections necessary to meet project requirements.

1.04 START-UP REQUIREMENTS

Do not operate units until ductwork is clean, filters are in place, bearings lubricated, condensate properly trapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been test run under observation.

1.05 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

B. Coordinate size and location of structural-steel support members.

1.06 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. Filters: One set for each modular indoor air-handling unit.
- 2. Fan Belts: One set for each modular indoor air-handling unit fan.

PART 2 — PRODUCTS

2.01 APPROVED MANUFACTURES

- A. TRANE
- B. CARRIER
- C. DAIKIN

2.02 MANUFACTURES WARRANTY

- A. Warranty: COMPLETE 5 year whole unit parts, labor, and refrigerant warranty by the manufacturer.

2.03 CASING

A. Construction:

1. Unit shall be constructed of a complete frame with easily removable panels. Removal of any panel shall not affect the structural integrity of the unit.
2. All units shall be supplied with a perimeter, 14-gage or heavier, G-90 galvanized, high tensile steel base rail with a pocket to accommodate roof curb. Perimeter lifting lugs for overhead lifting shall be provided on each shipping section. Sliding units in place of lifting lugs shall not be acceptable.
3. Unit shall be thermally broken to minimize the conduction path from the inside of the casing to the outside.
4. Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, and shall have one of the following exterior finishes as specified:
 - a. Pre-painted with a baked enamel finish passing 500-hour salt spray test (ASTM B-117) for pre-painted steel and 125-hour marine level 1 cohesion test (ASTM G-85.A5) for pre-painted steel.
5. Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, and shall have one of the following interior finishes as specified:
 - a. Unpainted G-90 galvanized steel.
6. Roof shall be double-wall, pitched in four directions at a minimum roof slope of 1/4-in. per foot across the width of the unit. No penetrations shall be made in pressure sensitive panels. Roof shall incorporate a standing top seam. All seams in the roof shall be gasketed and capped to prevent water infiltration into the unit.
7. Casing panels (top, sides, and bottom) shall be one piece double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

8. Casing deflection shall not exceed a 1:200 ratio when subject to an internal pressure of ± 8 -in. wg. Casing leakage rate shall be less than 1% at ± 8 in. wg of nominal unit airflow or 50 cfm, whichever is greater. Leakage rate shall be tested and documented on a routine basis on random production units.
9. Side panels shall be easily removable for access to unit and shall seal against a full perimeter automotive style gasket to ensure a tight seal.
10. The panel retention system shall comply with UL 1995 which states all moving parts (for example, fan blades, blower wheels, pulleys, and belts) that, if accidentally contacted, could cause bodily injury, shall be guarded against accidental contact by an enclosure requiring tools for removal.
11. Base rail shall overhang the curb to facilitate water run-off and protection of the curb to base connection from water intrusion.
12. Accessibility options shall be as follows:
 - a. Hinged double-wall access door on either side with removable access panel(s) on the other side.
13. Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used. Painted welds on unit exterior steel or galvanized steel are not acceptable.
15. All coil sections shall be solid double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

B. Access Doors:

Access doors shall be one piece double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

C. Drain Pans:

Drain pans shall be insulated double-wall stainless steel construction. The pan shall be sloped toward the drain connection. Drain pan shall have 1 1/2-in. MPT connection exiting through the hand side or opposite side of the casing as specified. Drain connection shall be insulated from the drain pan to the point at which it exits the casing. One drain outlet shall be supplied for each cooling coil section. Drain pan shall allow no standing water and comply with ASHRAE Standard 62.1-2010. Where 2 or more coils are stacked in a coil bank, intermediate drain pans shall be provided and the condensate shall be piped to the bottom drain pan. The bottom coil shall not serve as a drain path for the upper coil.

2.04 FANS

A. General:

1. Forward-curved fans shall have one double-width double-inlet (DWDI) fan wheel and scroll. They shall be constructed of galvanized steel with baked enamel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class II). Completed fan assembly shall be dynamically balanced in accordance with 1989 ARI Guideline G and ANSI S2.19-1986 at design operating speed using contract drive and motor if ordered.
2. Airfoil fan sections shall have one DWDI airfoil fan wheel and scroll. Airfoil blades shall be double thickness design constructed of heavy gage, high strength steel or aluminum continuously welded to the backplate and the spun inlet flange. Entire fan assembly shall be cleaned, primed and painted with alkyl enamel, except for an aluminum fan wheel when supplied. Fans shall have an AMCA class

rating corresponding to the static pressure at which the fan is designed to operate (Class II). Completed fan assembly shall be dynamically balanced to minimum grade of G 6.3 per ANSI/ AMCA 204-96 at design operating speed using contract drive and motor if ordered.

3. Fan assembly vibration shall not exceed 0.248 in. per second when mounted on active isolators. Vibration shall be measured in both vertical and horizontal directions at the specified fan operating speed using specified motor. Accelerometers shall be mounted on the motor near the bearing locations.
6. All fan sled components shall provide corrosion protection to pass 100-hour salt spray test per ASTM B-117.
7. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected with a maximum operating speed 25% below the first critical.
8. Belt drive fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be premium efficiency, open drip-proof with size and electrical characteristics as shown on the equipment schedule. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members. All three-phase motors shall have a $\pm 10\%$ voltage utilization range and a 1.15 minimum service factor. Motor shall be compliant with the Energy Independence and Security Act (EISA) of 2007 where applicable.

B. Performance Ratings:

Fan performance shall be rated and certified in accordance with AHRI Standard 430.

C. Sound Ratings:

Manufacturer shall submit first through eighth octave sound power for fan discharge and casing radiated sound. Sound ratings shall be tested in accordance with AHRI 260.

D. Mounting:

Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a common base assembly. The base assembly is isolated from the outer casing with factory-installed isolators and vibration absorbent an discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable. Units shall use 2-in. deflection spring isolators.

E. Flexible Connection:

The base assembly is isolated from the outer casing with factory-installed isolators and vibration absorbent fan discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable.

2.05 BEARINGS AND DRIVES

A. Bearings:

Self-aligning, grease lubricated, anti-friction with lubrication fittings extended to drive side of fan section. All bearing life calculations shall be done in accordance with ABMA 9 for ball bearings and ABMA 11 for roller bearings.

1. Size 03 to 110 forward-curved fans: Heavy-duty pillow block type, self-aligning, regreasable ball or roller type bearings selected for a minimum average life (L50) of 200,000 hours.
2. Size 03 to 110 airfoil fans: Heavy-duty pillow block type, self-aligning, regreasable ball or roller type bearings selected for a minimum average life (L50) of 200,000 hours or optionally for an (L50) of 500,000 hours.

B. Shafts:

Fan shafts shall be solid steel, turned, ground, polished and coated with a rust inhibitor.

C. V-Belt Drive:

Drive shall be designed for a minimum 1.5 service factor option and a factory-supplied extra set of belts. All drives shall be factory mounted, with sheaves aligned and belts properly tensioned.

2.06 COILS

A. All water coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with AHRI Standard 410. All water and direct expansion coils shall be tested at 450 psig air pressure.

B. General Fabrication:

1. All water and refrigerant coils shall have minimum 1/2-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches.
4. Aluminum-finned coils shall be supplied with die-formed casing and tube sheets of stainless steel as specified.

C. Hydronic Heating and Cooling Coils:

1. Headers shall be constructed of steel with steel MPT connections. Headers shall have drain and vent connections accessible from the exterior of the unit.
2. Configuration: Coils shall be drainable, with non-trapping circuits. Coils will be suitable for a design working pressure of 300 psig at 200 F.

2.07 FILTER SECTIONS

A. Flat filter sections shall accept either 2-in. . filters. Sections shall include side access slide rails.

2.08 DAMPERS

A. Mixing boxes, filter-mixing boxes shall have parallel blades and interconnecting outside-air and return-air dampers.

1. Standard Dampers:

Damper blades shall be constructed of galvanized steel, with blade seals and stainless steel jamb seals. Blades shall be mechanically fastened to axle rods rotating in self-lubricating synthetic bearings. Maximum leakage rate shall be 4 cfm/ft² at 1 in. wg (0.25 kPa) differential pressure.

2.09 UV-C GERMICIDAL LAMPS

A. Emitters and fixtures for UV-C lamps shall be designed for use inside an HVAC system and shall be covered by a 1 year warranty. Individual lamp output shall be measured in an ASME nozzled test apparatus using a 45 F airstream moving at not less than 400 fpm. Lamp output at 253.7 nm shall not be less than 10 \square W/cm² per inch of arc length measured at a distance of one meter.

B. Power supplies for UV-C lamps shall be a high-efficiency electronic type which are matched to the emitters and are capable of producing the specified output intensity with an input power no more than 80 watts.

- C. Fixtures for UV-C lamps shall be factory installed and wired to a SPDT disconnect switch and door interlock switches in each door. Fixtures are wired for 120 v/single ph requiring a minimum circuit ampacity of 15 amps. Lamps shall ship separately for field installation to minimize the chance for bulb damage.
- D. Emitters and fixtures shall be installed in sufficient quantity and arranged so as to provide an equal distribution of UV-C energy on the coil and drain pan.
- E. The minimum UV-C energy striking the leading edge of the coil pan shall be not less than 820 W/cm^2 at the closest point and through placement, not less than 60% of that value at the farthest point. Equal amounts are to strike the drain pan, either directly or indirectly through reflection.
- F. Emitters and fixtures shall be installed such that UV-C energy strikes all surfaces of the coil, drain pan, and the available line of sight airstream.
- E. Variable Frequency Drives:
 - 1. Factory-mounted variable frequency drives (VFDs) shall be wired to factory-supplied motors.
 - 2. Factory-supplied VFDs are programmed and started up from the factory and qualify the VFD, through ABB, for a 24-month warranty from date of commissioning or 30 months from date of sale, whichever occurs first.
 - 3. The VFD parameters are programmed into the controller and removable keypad. In the event that the VFD fails and needs replacement, the program can then be uploaded to the replacement VFD via the original keypad.
 - 4. The VFD shall be mounted inside the unit cabinet shielded from upstream components and within the unit's ambient conditions. Access to the VFD shall be through the unit's hinged access door.
 - 5. The VFD package as specified herein shall be enclosed in a UL Listed type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO 9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 - a. Environmental operating conditions: VFDs shall be capable of continuous operation at -15 to 40 C (5 to 104 F) ambient temperature with no frost allowed as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFDs that can only operate at 40 C intermittently (average during a 24-hour period) and therefore must be oversized. VFDs shall be capable of operating at altitude 0 to 3300 ft above sea level and less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
 - b. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFDs without these ratings are not acceptable. Type 1 enclosures with only NEMA ratings are not acceptable (must be UL Type 1).
 - 6. All VFDs shall have the following standard features:
 - a. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - b. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto"

modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.

- c. There shall be a built-in timeclock in the VFD keypad. The clock shall have a battery back-up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/ stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the timeclock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
- d. The VFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
- e. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.
- f. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
- g. The VFD shall have the ability to automatically restart after an overcurrent, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
- h. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/ UL table 430.250 for 4-pole motors.
- i. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.
- j. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFDs with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.
- k. The VFD shall include a coordinated AC transient surge protection system consisting of 4 to 120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- l. The VFD shall provide a programmable loss-of- load (broken belt/broken coupling) Form- C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and/or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
- m. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure/jam condition causing motor overload

- n. The VFD shall include multiple “two zone” PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4 to 20 mA, 0 to 10V, and/or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for “two zone” control.
 - o. If the input reference (4 to 20 mA or 2 to 10 V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
 - p. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
7. All VFDs to have the following adjustments:
- a. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
 - b. Two (2) PID set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
 - c. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
 - d. Two (2) programmable analog inputs shall accept current or voltage signals.
 - e. Two (2) programmable analog outputs (0 to 20 mA or 4 to 20 mA). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
 - f. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24 VDC or 24 VAC.
 - g. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.
 - h. Run permissive circuit: There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, timeclock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD

motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing." The safety input status shall also be transmitted over the serial communications bus. i. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 to 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications).

- j. Seven (7) programmable preset speeds.
 - k. Two independently adjustable accelerate and decelerate ramps with 1 to 1800 seconds adjustable time ramps.
 - l. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
 - m. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
 - n. The VFD shall include password protection against parameter changes.
8. The keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alphanumeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
- a. Start-up assistant
 - b. Parameter assistants
 - c. PID assistant
 - d. Reference assistant
 - e. I/O assistant
 - f. Serial communications assistant
 - g. Option module assistant
 - h. Panel display assistant
 - i. Low noise set-up assistant
 - j. Maintenance assistant
 - k. Troubleshooting assistant
 - l. Drive optimizer assistants
9. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

- a. Output Frequency
 - b. Motor Speed (RPM, %, or Engineering units)
 - c. Motor Current
 - d. Motor Torque
 - e. Motor Power (kW)
 - f. DC Bus Voltage
 - g. Output Voltage
10. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500 Hz (reverse) to 500 Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install modular outdoor air-handling units with the following vibration control devices. "
 - 1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases.
- B. Arrange installation of units to provide access space around modular outdoor air-handling units for service and maintenance.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to modular outdoor air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4 (DN 32), Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Chilled-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Connect to supply and return coil tapplings with shutoff or balancing valve and union or flange at each connection.
- F. Refrigerant Piping (where applicable): Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Connect to supply and return coil tapplings with shutoff valve and union or flange at each connection.
- G. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.
- H. Electrical: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.
- I. Ground equipment according to Division 16 Section "Grounding and Bonding."
- J. Tighten electrical connectors and terminals according to manufacturer's published torquetightening 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 field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan 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.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Final Checks before Startup: Perform the following:
 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, starters, and disconnect switches.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 6. Set zone dampers to fully open position for each zone.
 7. Set outside- and air mixing dampers to minimum outside-air setting.
 8. Comb coil fins for parallel orientation.
 9. Install clean filters
 10. Verify that manual and automatic volume control and fire dampers in connected duct

systems are in fully open position.

C. Starting procedures for modular indoor air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean modular outdoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing modular indoor air handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units. Refer to Division 1 Section

END OF SECTION

SECTION 15815

METAL DUCTS

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 rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2490 Pa).
- B. Related Sections include the following:
 - 1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.
 - 2. Division 15 Section "Diffusers, Registers, and Grilles."
 - 3. Division 15 Section "Testing, Adjusting, and Balancing" for air balancing and final adjusting of manual-volume dampers.

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula $\text{Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$ or $\text{W/m} \times \text{K}$ at the temperature differences specified. Values are expressed as Btu or W.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect.

1.5 SUBMITTALS

- A. Product Data: For duct liner and sealing materials.
- B. Shop Drawings: Show details of the following:
 - 1. Duct layout indicating pressure classifications and sizes on plans.
 - 2. Fittings.
 - 3. Penetrations through fire-rated and other partitions.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 - 2. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

- D. Duct Construction Standards: Provide a copy of the duct construction standards to be used for each pressure classification in this project. Duct Construction Standards must comply with the latest edition of SMACNA "HVAC Duct Construction Standards – Metal and Flexible."
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation
- D. Deliver and store all ductwork with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
- E. Any installed ductwork or piping system left temporarily incomplete shall be covered with protective material until final connections can be installed.
- F. All ductwork and/or liner insulation to be wrapped with protective material until installation. Any ductwork or insulation left exposed to the environment or contaminating particulate matter shall be replaced at the contractor's expense.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.

- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
 - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Comply with latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Fabricate range hood exhaust ducts with 0.0598-inch- (1.5-mm-) thick, galvanized sheet for concealed ducts and 0.0500-inch- (1.3-mm-) thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
- C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- (1.3-mm-) thick stainless steel. Weld and flange seams and joints.
- D. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

1. Supply Ducts between AHU and Air Terminal Units: 3-inch wg (750 Pa).
 2. Supply Ducts after air terminal units and on constant volume supply equipment: 1-inch wg (250 Pa), positive pressure
 3. Return Ducts: 1-inch wg (500 Pa), negative pressure.
 4. Exhaust Ducts: 1-inch wg (500 Pa), negative pressure.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of unbraced panel area, unless ducts are lined.

2.5 ROUND FABRICATION

- A. Round Ducts: Fabricate spiral seam supply and return ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Snap Lock Longitudinal seam ductwork will not be allowed. Adjustable elbows will not be allowed.
- B. Spiral seam round or oval duct may be substituted for rectangular duct at the contractors option. Spiral seam ductwork sizing must result in the same or less pressure drop than the rectangular duct indicated on the plans.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 10 feet (3 m), unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with

sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).

- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Sections.

3.2 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F (1100 deg C) 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 15-foot (4.6-m) intervals; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

3.3 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.4 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." All duct to be sealed to SMACNA seal class A which requires sealing all tranverse joints, longitudinal seams and duct wall penetratrions regardless of pressure classification.
- B. Seal externally insulated ducts before insulation installation.
- C. All ducts shall be inspected after sealing is complete and prior to insulation installation. Provide the engineer with a minimum 7 days notice prior to beginning duct insulation.

3.5 HANGING AND SUPPORTING

- A. Install rigid round and rectangular metal duct with support systems indicated in the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet (5 m) and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.6 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.7 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
 - B. 25% of the duct installed after the air handling units and prior to the air terminal units shall be tested in the presence of the Architect, at static pressures equal to maximum design pressure of system or section being tested. The sections of duct to be tested shall be chosen by the architect or engineer after installation of the duct. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."
 - D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg (500 to 2490 Pa).
 - E. Remake leaking joints and retest until leakage is less than maximum allowable.
- 3.8 CLEANING**
- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION

SECTION 15820
DUCT 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:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors and panels.
 - 6. Flexible ducts.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.
- B. Related Sections include the following:
 - 1. Division 8 Sections for wall- and ceiling-mounted access doors and panels.
 - 2. Division 10 Sections for intake and relief louvers and vents connected to ducts and installed in exterior walls.
 - 3. Division 15 Section "Diffusers, Registers, and Grilles."
 - 4. Division 16 Sections for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual- and automatic-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- D. Blade Seals: Vinyl.
- E. Blade Axles: Galvanized steel.
- F. Tie Bars and Brackets: Galvanized steel.
- G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
- C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Fire Rating: One and one-half hours.
- D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film.
 - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
- D. 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 shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 15 Section "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15820
DUCT 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:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors and panels.
 - 6. Flexible ducts.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.
- B. Related Sections include the following:
 - 1. Division 8 Sections for wall- and ceiling-mounted access doors and panels.
 - 2. Division 10 Sections for intake and relief louvers and vents connected to ducts and installed in exterior walls.
 - 3. Division 15 Section "Diffusers, Registers, and Grilles."
 - 4. Division 16 Sections for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual- and automatic-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- D. Blade Seals: Vinyl.
- E. Blade Axles: Galvanized steel.
- F. Tie Bars and Brackets: Galvanized steel.
- G. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
- C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hours.
- C. Fire Rating: One and one-half hours.
- D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
- E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film.
 - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
- D. 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 shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 15 Section "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15837
CENTRIFUGAL FANS

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 centrifugal fans and vent sets.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA standards.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit scheduled and 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 gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in Division 1.

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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural support members and/or shaft locations.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.

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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cook, Loren Company.
 - 2. Greenheck.

2.2 HOUSINGS

- A. Roof Mounted Centrifugal Exhaust Fan.
 - 1. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

2.3 WHEELS

- A. Roof Mounted Centrifugal Exhaust Fan
 - 1. 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.

2.4 SHAFTS

- A. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
- B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
- C. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

2.5 BEARINGS

- A. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L₅₀ of 200,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L₅₀ of 200,000 hours.

2.6 BELT DRIVES

- A. Description: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor: 1.5.
- B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
- C. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
- D. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
- E. Motor Mount: Adjustable for belt tensioning.

2.7 ACCESSORIES

- A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
- B. Companion Flanges: Galvanized steel, for duct connections.
- C. Scroll Drain Connection: **NPS 1 (DN 25)** steel pipe coupling welded to low point of fan scroll.
- D. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
- E. Spark-Resistant Construction: AMCA 99 (where required).
- F. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- G. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.8 MOTORS

- A. Refer to Division 15 Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, high efficiency, Design B.
- C. Enclosure Type: [Open dripproof] [Totally enclosed, fan cooled].

2.9 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with 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. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label fans according to requirements specified in Division 15 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Ground equipment.
- D. 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 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 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. Verify lubrication for bearings and other moving parts.

- 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.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.5 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.
 - 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 "Closeout Procedures."
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 15845
AIR TERMINAL UNITS

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. Single-duct air terminals.
 - 2. Fan Powered Terminal Units

1.3 SUBMITTALS

- A. Product Data: Include rated capacities; operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating air outlets with other items installed in ceilings.
- D. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals specified in Division 1.
- E. Include scheduled listing discharge and radiant sound power levels (logarithmic power levels for the combination of both valve and fan at the worst case) for each second through seventh octave bands for every terminal box scheduled. Data provided shall conform to ARI Standard 880, at a 2.5" inlet static pressure. Refer to terminal box schedules for values of external static pressure, air quantities (fan and primary) and minimum pressure loss through the terminal unit.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Standards.

- C. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- D. Comply with NFPA 70 for electrical components and installation.

PART 2. - PRODUCTS

2.1 MANUFACTURERS

- A. Single-duct Air Terminal Manufacturers: Subject to compliance with requirements, provide air terminals by one of the following:
 - 1.
 - 2.
 - 3. Titus.
 - 4. Price

2.2 FABRICATION

- A. Casings: Galvanized sheet metal of the following minimum thicknesses:
 - 1. Upstream Pressure Side: 0.0239-inch (0.6-mm) 24 gauge steel.
 - 2. Downstream Pressure Side: 0.0179-inch (0.45-mm) 30 gauge steel.
- B. Casing Lining: Minimum of 1/2-inch- (13-mm-) thick, [vinyl-coated] fibrous-glass insulation; 1.5-lb/cu. ft. (24-kg/cu. m) density, complying with NFPA 90A requirements and UL 181 erosion requirements. Secure lining to prevent delamination, sagging, or settling.
 - 1. Coat liner surfaces and edges with erosion-resistant coating.
- C. Plenum Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
- D. Plenum Air Outlets: S-slip and drive connections.
- E. Access: Removable panels to permit access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
- F. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: 2 percent of nominal airflow at 2-inch wg (250-Pa) inlet static pressure.
- G. Controller shall be capable of maintaining design flow plus 5% regardless of inlet static pressure from minimum specified to 4" wg.

2.3 CONTROLS:


- A. Factory-mounted and -wired controls: Mount electrical components in control box with removable cover. Incorporate single-point electrical connection to power source.
 - 1. Factory-mounted transformer for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 - 2. Wiring Terminations: Fan and controls to terminal strip, and terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box sized according to NFPA 70.
 - 3. Disconnect Switch: Factory-mounted, fused, disconnect switch.

- B. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

2.4 SINGLE-DUCT AIR TERMINALS

- A. Configuration: Volume-damper assembly inside unit casing. Locate control components inside protective metal shroud.
- B. Electric Heating Coil: Slip-in type, open-coil design with integral control box factory wired and installed. Include the following features:
 1. Minimum airflow switch.
 2. Magnetic contactor for each step of control.

2.5 FAN POWERED AIR TERMINALS

1. Furnish and install Price variable volume fan powered terminal units (FDC5000) of the sizes and capacities as shown on the plan.
2. minimum cataloged air volume.
3. Sound ratings of air distribution assemblies shall not exceed NC at static pressure drop across the unit, and the downstream static pressure of.
4. The air flow sensor shall be of a cross configuration located at the inlet of the assembly. The sensor shall have twelve total pressure sensing ports and a center averaging chamber designed to accurately average the flow across the inlet of the assembly. Sensor shall provide accuracy within 5% with a 90° sheet metal elbow directly at the inlet of the assembly. The air flow sensor shall amplify the sensed air flow signal.
5. The assembly casing shall be constructed of zinc coated steel, internally lined with 3/4 inch thick, dual density fiberglass insulation which complies with UL-181 and NFPA-90A. Any cut edges of fiberglass exposed to the airstream shall be coated with NFPA-90A approved sealant.
6. Gauge of the assembly casing shall be as follows:
 - a. Casing width less than 36" - minimum 22 gauge.
 - b. Casing width 36" or greater - minimum 20 gauge.
7. Casing shall incorporate an internal sound reduction baffle.
8. Unit casing shall have a bottom access door to allow removal of fan and servicing of unit.
9. The Primary air valve damper shall be heavy gauge metal, with peripheral gasket, and solid steel shaft, pivoted in self-lubricating bearings. In the full closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" w.g. inlet static pressure, when tested in accordance with ASHRAE 130.
10. Fan blower shall be constructed of steel with forward curved blades, dynamically balanced wheels and direct drive motor. Motors shall be permanent split capacitor type, with lubricated bearings and thermal overload protection. Motor shall be designed for use with electronic fan speed controller. Provide isolation between motor and blower assembly.
11. Provide an electronic speed controller which allows continuously adjustable fan speed from maximum to minimum. Speed control shall be electronic and shall be matched to operate with the motor. Speed control shall be equipped with a minimum voltage stop to ensure motor will not operate in the stall mode. Voltage stop shall be factory adjusted.
12. Units shall incorporate a single point electrical and control connection for the entire unit. All electrical components shall be enclosed in a single control box with an access panel mounted on the side of the assembly. All controls shall be sealed from primary air flow. Units shall be ETL listed to meet UL1995 and CSA No. 236, and ARI certified.
13. ECM-Motor-Option
 

Motors shall be GE, ECMTM DC brushless motors complete with and operated by a single phase integrated controller / inverter that operates the wound stator and sensor motor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Motor ro-

to shall be permanent magnet type with near zero rotor losses. Motor shall be permanently lubricated with ball bearings. Motor shall maintain a minimum of 70% efficiency over its entire operating range. Motors shall be direct coupled to the blower. Provide isolation between motor and blower assembly. Provide manual fan speed control for field adjustment of fan air flow setpoint.

2.6 SOURCE QUALITY CONTROL

- A. Testing Requirements: Test and rate air terminals according to ARI Standards 880, "Industry Standard for Air Terminals."
- B. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3. EXECUTION

3.1 INSTALLATION

- A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.
- B. Connect ductwork to air terminals according to Division 15 ductwork Sections.

3.2 CONNECTIONS

- A. Install piping adjacent to air terminals to allow service and maintenance.
- B. Electrical: Comply with applicable requirements in Division 16 Sections.
- C. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL Standards.

3.3 ADJUSTING:

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 0% of design to 100% full flow.

3.4 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 COMMISSIONING

- A. Verify that installation of each air terminal is according to the Contract Documents.
- B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.
- C. Check that controls and control enclosure are accessible.
- D. Verify that control connections are complete.
- E. Check that nameplate and identification tag are visible.
- F. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shut-down, troubleshooting, servicing, and preventive maintenance.
 - 2. Review data in the maintenance manuals. Refer to Division 1.
 - 3. Review data in the maintenance manuals. Refer to Division 1.
 - 4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION

SECTION 15855
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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 10 Sections for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
 - 3. Division 15 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus.
 - 2. Price

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance 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. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- 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 practicable. . Coordinate device locations with ceiling grid, sprinklers, and lights. 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 connection 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.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 15860
AIR COOLED SCROLL WATER CHILLERS

PART 1 - GENERAL

1.01 SCOPE

- A. Section includes design, performance criteria, controls and control connections, chilled water connections, electrical power connections and refrigerants of the chiller package.

1.02 REFERENCES

- A. Products shall be designed, rated and certified in accordance with applicable sections of the following Standards and Codes:
 - 1. To comply with the most recent versions of applicable Standards and Codes of AHRI 550 / 590.
 - 2. AHRI 370 - Standard for Sound Rating of Large outdoor Refrigerating and Air-conditioning Equipment.
 - 3. To comply with the most recent versions of applicable Standards and Codes of ASHRAE 15.
 - 4. Units shall meet the efficiency standards of the latest ASHRAE 90.1 Standard.

1.03 QUALITY ASSURANCE

- A. UL 1995 -- Standard for Heating and Cooling Equipment.
- B. Manufactured facility to be ISO 9001.
- C. Factory Functional Test: The chiller shall be pressure tested, evacuated and fully charged with HFC-410A refrigerant and oil. In addition, a factory functional test to verify correct operation by cycling condenser fans, closing compressor contacts and reading data points from temperature and pressure sensors.
- D. Chiller manufacturer shall have a factory trained and supported service organization that is within a 75 mile radius of the site.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with the specifications.
- B. Submittals shall include the following:
 - 1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections.
 - 2. Product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

1.05 OPERATION AND MAINTENANCE DATA

- A. Include manufacturer's descriptive literature, installation checklist, start-up instructions and maintenance procedure.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be delivered to job site fully assembled and charged with refrigerant (unless selected with nitrogen charge) and oil by the manufacturer.
- B. Unit shall be stored and handled per manufacturer's instructions.
- C. During shipment, provide protective covering over vulnerable components. Fit nozzles and open pipe ends with enclosures.

1.07 WARRANTY

- A. Warranty: COMPLETE 5 year whole unit parts, labor, and refrigerant warranty by the manufacturer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. TRANE
- B. Carrier
- C. Daikin

2.02 GENERAL UNIT DESCRIPTION

- A. Factory assembled, single-piece chassis, air-cooled liquid chiller. Contained within the package shall be all factory wiring, piping, controls, and refrigerant charge (HFC-410A). Unit to be mounted on elastomeric isolators.
- B. Chiller full load and part load efficiency shall be equal or greater than base of design.

2.03 CABINET

- A. Frame shall be heavy-gage, with a powder coated paint finish for both aesthetic appeal and to offer more resistance to corrosion.
- B. Units shall be constructed of a galvanized steel frame with galvanized steel panels and access doors. Component surfaces shall be finished with a powder-coated paint. The coating or paint system shall withstand a 1000-consecutive-hour salt spray application in accordance with standard ASTM B117.
- C. Unit shall be provided with full louvers that consist of molded plastic louvers extending from the top of the unit down to the base rail of the chiller.

2.04 COMPRESSORS

- A. Fully hermetic scroll type compressors with R410A optimized and dedicated scroll profile.
- B. Direct drive motor cooled by suction gas with only three major moving parts and a completely enclosed

compression chamber which leads to increased efficiency.

- C. Each compressor will have crankcase heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

2.05 EVAPORATOR

- A. The evaporator shall be a high efficiency, brazed plate-to-plate type heat exchanger consisting of parallel plates. Braze plates shall be stainless steel with copper braze material.
- B. The evaporator shall be protected with an etched foil heater and insulated with 3/4 inch insulation. This combination shall provide freeze protection down to -20F ambient temperatures while the heater is powered. Contractor shall provide separate power to energize heater and protect evaporator while chiller is disconnected.
- C. The water side working pressure shall be rated at 150 psig and tested at 1.5 times maximum allowable water side working pressure.
- D. The refrigerant side working pressure shall be rated at 460 psig (29.6 bars) and tested at 1.1 maximum allowable refrigerant side working pressure

2.06 CONDENSER

- A. Provide a complete, flexible epoxy dip and back coating of condenser coils. Coil with coating shall be able to handle 5,000-hour sales spray test. All coil surfaces shall be coated with epoxy material giving uniform coverage (minimum of 0.8 mils), without bridging between fins.
- B. Any coating showing bridging will be unacceptable. Coatings not covering any part of the fin and/or arts of condenser frame will be unacceptable. Backed phenolic coatings are unacceptable because of their brittle nature. The heat transfer decrease due to the coating shall be less than 1% so that design capacity and efficiency are maintained. Baked phenolic coatings are also unacceptable due to performance losses of p to 5%. If backed phenolic is allowed, unit provided must account for performance degradation. Coating shall be flexible so that bare surfaces will not form. The coating shall be able to handle temperatures ranging from -50 F to 150 F without degradation. UV protection shall be applied on surface of coating to prevent degradation form sunlight.
- C. The maximum allowable working pressure of the condenser shall be 650 psig (44.8 bars). The condensers shall be factory proof and leak tested at 715 psig (49.3 bars).
- D. Low Sound Fans shall be dynamically and statically balanced, direct drive, corrosion resistant glass fiber reinforced composite blades molded into a low noise fan blade.
- E. Low speed fan motors shall be three-phase with permanently lubricated ball bearings and individually protected by circuit breakers.
- F. Unit shall be capable of starting and running at outdoor ambient temperatures from 32F to 125F (0C - 52C) for all sizes.

2.07 ENCLOSURES

- A. Mount starters in a UL1995 rated panel for outdoor use.
- B. The starter shall be across-the-line configuration, factory-mounted and fully pre-wired to the

compressor motor(s) and control panel.

- C. A control power transformer shall be factory-installed and factory-wired to provide unit control power.
- D. Control panel shall be dead front construction for enhanced service technician safety.
- E. A molded case standard interrupt capacity circuit breaker shall be factory pre-wired with terminal block power connections and equipped with an lockable external operator handle making it available to disconnect the chiller from main power.
- F. Unit wiring shall run in liquid tight conduit.

2.08 REFRIGERATION COMPONENTS

- A. Each refrigerant circuit shall include a filter drier, electronic expansion valve with site glass, liquid line service valves and a complete operating charge of both refrigerant HFC-410A and compressor oil.
- B. Each refrigerant circuit shall include a discharge line service valve to allow the refrigerant to be isolated in the condenser.

2.09 CONTROLS, SAFETIES AND DIAGNOSTICS

- A. The microprocessor-based unit controller shall be factory-installed and factory-tested.
- B. The unit display shall provide the following data:
 - 1. Water and air temperatures
 - 2. Refrigerant levels and temperatures
 - 3. Flow switch status
 - 4. Compressor starts and run times
- C. The unit controller shall provide chilled water reset based on return water as an energy saving option.
- D. The unit shall shut down if one or more of the following safeties has been breached:
 - 1. Low evaporator refrigerant temperature and/or pressure
 - 2. High condenser refrigerant pressure
 - 3. Low oil flow
 - 4. Motor current overload
 - 5. High compressor discharge temperature
 - 6. Electronic distribution faults: phase loss, phase imbalance, or phase reversal
- E. Unit shall be shipped with factory control and power wiring installed.

2.10 CHILLED FLUID CIRCUIT

- A. Chilled fluid circuit shall be rated for 150 psig (1034 kPa) working pressure.
- B. Proof of flow switch shall be provided by the equipment manufacturer and installed the correct number of pipe diameters from any elbow and in the correct orientation.
- C. Units with brazed plate evaporators shall have a water strainer that is factory provided. It shall be installed with a blowdown valve to facilitate periodic cleaning of the strainer to prevent it from becoming clogged.

2.11 CHILLER WATER PUMPS

- A. NONE.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install chiller per manufactures recommendations.

3.02 MANUFACTURER'S FIELD SERVICES

- A. OEM Startup is performed by factory trained and authorized servicing technicians confirming equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.

1. Included OEM Factory Startup:

- a. Scroll Chillers

- B. Applied Chiller manufacturers shall maintain service capabilities no more than 50 miles from the jobsite.

- C. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION

SECTION 15900
HVAC CONTROLS

PART 1- GENERAL

1.1 SECTION INCLUDES

1. Products Furnished But Not Installed Under This Section
2. Products Installed But Not Furnished Under This Section
3. Products Not Furnished or Installed But Integrated with the Work of this Section
4. Related Sections
5. Description
6. Approved Control System Contractor
7. Quality Assurance
8. Codes and Standards
9. System Performance
10. Submittals
11. Warranty
12. Ownership of Proprietary Material

1.2 PRODUCTS THAT MAY BE FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Division 23 - Ductwork Accessories:

1. Automatic Dampers Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
 - a) Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.
 - b) Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal $\pm 1/8"$.
 - c) Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
 - d) Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
 - e) Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
 - f) Provide a visible and accessible indication of damper position on the drive shaft end.
 - g) Support duct-work in area of damper when required to prevent sagging due to damper weight.

- h) After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

- 2. Airflow Stations

- 3. Terminal Unit Controls

1.2 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work.

1.3 DESCRIPTION

The system shall be a new standalone control system as indicated on the drawings and described in the specifications. Control functions within a building site shall be performed by localized direct digital controls linked through a peer-to-peer network of building controllers. The system shall provide a web-based user interface and be designed to integrate multiple BACnet-based systems together, collect, store and display historical data and provide enterprise-wide or multiple building facilities management capabilities from a central storage and operational location.

An operator shall be able to logon to the system using a standard web browser, and without requiring system vendor-proprietary software installed on the user's PC to allow access to all appropriate data and control functions.

Phase 2 of this project(NOT IN THIS CONTRACT) will entail control system integration to the existing Schneider building controls .

- A. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.
- C. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
- D. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A network communications card shall be provided for each building control panel provided as part of the system installation. All network protocol standards shall utilize ASHRAE BACnet MSTP at the controller level & BACnet IP at the Enterprise Level.

1.4 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

A. Approved Control System Contractors and Manufacturer:

a. **SCHNEIDER – EcoStruxure**

i. *This campus currently has an existing Schneider Controls System.*

b. **Automated Logic Corp - WebCTRL**

1.5 QUALITY ASSURANCE

A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office within 30 miles of the project site and provide [24-hour] response in the event of a customer call.

1.6 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Building Code (IBC)
3. International Mechanical Code (IMC)
4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
5. ANSI UL 864 UUKL Smoke Management

1.7 SYSTEM PERFORMANCE

- A. Data values displayed on web pages (that represent live data) shall automatically refresh at a minimum rate of every 10 seconds in the browser without refreshing the entire page.
- B. Data on web pages must be returned and updated on a given web page within 5 seconds on average after the web page is initially delivered, subject to network loading.
- C. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points with current data displayed within 10 seconds of the request.

- D. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
- E. Multiple Alarm Annunciations. Any authorized operator shall be able to view alarms through a web page interface, with up to 40 concurrent users accessing the system alarm data.
- F. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	$\pm 1^{\circ} \text{ F}$
Ducted Air	$\pm 2^{\circ} \text{ F}$
Outside Air	$\pm 2^{\circ} \text{ F}$
Water Temperature	$\pm 1^{\circ} \text{ F}$
Delta-T	$\pm 0.25^{\circ} \text{ F}$
Relative Humidity	$\pm 5\% \text{ RH}$
Water Flow	$\pm 5\% \text{ of full scale}$
Air Flow (terminal)	$\pm 10\% \text{ of reading}$ *Note 1
Air Flow (measuring stations)	$\pm 5\% \text{ of reading}$
Air Pressure (ducts)	$\pm 0.1 \text{ "W.G.}$
Air Pressure (space)	$\pm 0.01 \text{ "W.G.}$
Water Pressure	$\pm 2\% \text{ of full scale}$ *Note 2
Electrical Power	$\pm 5\% \text{ of reading}$ *Note 3
Carbon Monoxide (CO)	$\pm 5\% \text{ of reading}$
Carbon Dioxide (CO ₂)	$\pm 50 \text{ PPM}$

Note 1: Within (10%-100% of scale)

Note 2: For both absolute and differential pressure

Note 3: Not including utility supplied meters

1.10 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the

Engineer and Owner have reviewed submittals for conformity with the plan and specifications. Six (6) copies are required.

- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within 60 days of contract award:
 - 1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 - 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
 - 3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
 - 4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - a) Centralized server hardware and software
 - b) Building Controllers
 - c) Custom Application Controllers
 - d) Application Specific Controllers
 - e) Operator Interface Computer(s) as specified
 - f) Configuration and service software programs
 - g) Portable Operator Workstation(s) or Service software PCs as specified
 - h) Auxiliary Control Devices
 - i) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
 - j) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
 - k) Points list showing all system objects, and the proposed English language object names
 - l) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
 - m) Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal

n) Color prints of proposed graphics with a list of points for display

E. Project Record Documents. Upon completion of installation submit **three (3) copies** of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
2. Testing and Commissioning Reports and Checklists.
3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b) Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c) Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
 - d) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
 - f) One set of electronic media containing files of all color-graphic screens created for the project.
 - g) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
 - h) Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - i) Licenses and warranty documents for all equipment and systems.
 - j) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.

F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.11 WARRANTY

A. Warrant all work as follows:

1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
3. Central server and configuration tool software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.
4. The system provider shall provide a web-accessible on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project-specific application programming code
5. All documentation

PART 2-PRODUCTS

2.0 SECTION INCLUDES

- .1 Materials
- .2 Communication
- .3 Operator Interface
- .4 Application and Control Software
- .5 Building Controllers
- .6 Custom Application Controllers
- .7 Application Specific Controllers

- .8 Input/Output Interface
- .9 Auxiliary Control Devices

2.1 MATERIALS

All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract

2.2 COMMUNICATION

A. Wireless equipment controllers and auxiliary control devices shall conform to:

1. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
2. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.
3. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the wireless network health.
4. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E
5. Shall be ZigBee Building Automation Certified to allow wireless integration with products from multiple suppliers.
6. To support network setup and troubleshooting, service tools shall display link quality and hop quantities for each wireless device.
7. Wireless service tool access to comm link shall be provided to minimize installation and trouble shooting labor.

B. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.

2.3 OPERATOR INTERFACE

- A. PC-based workstations on the owner's intranet/internet shall have WEB based access to the system based on username & password authority levels.
- B. Provide a web browser user interface. There shall be no vendor-proprietary software required to be installed on user PCs.

1. The system shall provide summary tables by equipment type per site. Room or space summary tables shall provide names, space temperatures, setpoints, and variance from setpoint. Provide a means to sort columns of data viewed by ascending or descending value for any chosen data type.
2. The system shall provide a user option to reformat summary tables and information for printing.
3. The central server shall be capable of presenting selected data parameters such that they may be viewed and changed by the user. For example, adjustable data parameters may include space temperature setpoints, relative humidity setpoints, discharge air setpoints, static pressure setpoints,
4. Provide the ability to reset diagnostic messages and perform control overrides

C. Central Server Components. The central server shall consist of the following (minimum):

1. System shall utilize a server class PC, tower or rack mounted
2. Two Xeon 2.8GHz, 1MB L3 cache processors
3. 2GB, DDR266 SDRAM memory
4. Four (4) 73GB SCSI HD (each) in RAID 5 or RAID 10 configuration
5. DVD+R/W or CD ROM
6. Microsoft Windows Server 2003 (IIS 6.0)
7. Microsoft SQL Server 2005
8. NET Framework 1.1
9. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. The server shall include a minimum 17", color monitor with 1024 x 768 screen resolution.

D. System Software

1. System Graphics. The operator interface shall provide graphically-oriented web pages as designated. Two dimensional graphics are strictly prohibited.
 - a) 3D Area Map
 - b) 3D Equipment Graphics with Animation
 - c) 3D Extruded Thermal Graphic Floor Plans showing ductwork runs, registers & equipment locations.
 - d) Lighting Floor Plan Graphics
 - e) Fire Alarm Floor Plan Graphics
 - f) Integrated System Graphics
 - g) Provide a method for the operator to easily move between graphic displays on the screen.
 - h) The system must dynamically generate and serve web pages based on standard or custom web page templates in combination with content derived from the database in any building control panel.

- i) Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.
 - 2. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by user to select the desired units for each measurement.
 - 3. Site Management
 - a) The system must allow for grouping of the many sites in an enterprise in a logical manner.
 - b) The system shall provide a search function to allow users to search for sites or groups of sites by name or partial names.
 - c) The system must provide the necessary means to add, remove, and manage sites.
- E. System Applications. The central server shall serve operator interface web pages and provide off-line storage of system information. Provide the following applications within the system.
 - 1. Automatic System Database Save and Restore. The central server shall store on the hard disk backup tables of data including trends, alarms, custom settings and user profiles. This data shall be backed up once a day. This database shall be updated whenever a change is made in the system. The storage of this data shall be automatic and not require operator intervention.
 - 2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database manually at any time.
 - 3. System Configuration. The central server shall serve web pages as the interface for configuring the operator-level functions of the system. A user with proper security shall be able to configure the system to allow for future changes or additions.
 - 4. On-Line Help and Training. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all system functions and shall provide the relevant data for that particular screen. Additional help shall be available through the use of hypertext links onscreen.
 - 5. Security. The system shall support state-of-the-art encryption between server and web browser. Web browser interface shall utilize Secure Socket Layer SSLv3 encryption technology. Web server shall utilize TLS encryption. Server security shall accommodate a minimum of 1000 individually password protected users. Each user shall be assigned a user name and password and security level. User names and passwords shall be case sensitive and able to have up to 32 characters. User security shall be set up through the web browser as an administrative function. Each user will be assigned to a security level. Security levels shall be hierarchical in nature – the higher security levels have all rights of lower levels. There shall be at least four (4) user security levels corresponding to user roles. A System Administrator shall be able to define the data view and edit capabilities for each security level. Users shall be automatically logged off of the system after a specified period of inactivity.
 - 6. System Diagnostics. The system shall automatically monitor the operation of all workstations, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
 - 7. Alarm Management - The central server shall provide the following alarm handling functions:
 - a) Receiving alarms from each building panel.
 - b) The central server shall store specified alarms in an alarm log database.
 - c) Displaying an alarm log.

- d) Forward alarms via e-mail as specified by the user.
 - e) Alarm sorting and/or filtering by alarm and/or site attribute.
 - f) Store alarm data in a standard format accessible to a user-specified peer database/server.
 - g) Storing and purging the alarm log.
 - h) Provide a means of acknowledging and deleting alarms from the viewable alarm log(s).
 - i) Provide a printer-friendly format for printing alarm logs.
 - 8. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the central server.
 - 9. Trend Logs. The operator shall be able to define a trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1, 5, 15, 30, and 60 minutes as well as user-defined intervals shall be selectable. The system operator shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel, then harvested and be archived on the central server hard disk. Additionally, provide the capability to sample directly from the building controller database to the central server. Trend data shall be able to be viewed and printed from the operator interface web pages. Trends must be viewable in a text-based format or graphically. Trends shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages, and be exportable to a file for use in other software tools, available in a non-proprietary file format to be used by another database.
 - 10. Dynamic Graphical Trending. The system shall have the ability to display collected data in a graphical chart. Trend viewing capabilities shall include the ability to show up to 5 points on a chart. Each data point trend line shall be an individual color. Trend data shall be able to be stored indefinitely on the central server, based on server storage capacity and data archiving practices.
 - 11. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system.
 - 12. Reports and Logs. Provide a reporting function that presents the system operator stored data in either a table format, as a chart, or as a report that can be printed. Data in a table format shall list the data values as well as a date and time stamp. Allow the user to present data log pages of a collection from a single piece of equipment or a building panel summary. Provide the ability to view data points on a static graph or configured for a specified length of time. The system shall be capable of storing trend data in a database, and providing an interface to allow for retrieval of data by network peer servers and databases.
- F. Workstation Applications Editors. The system web user interface shall support dedicated screens for editing of control system applications. The application programs shall be executed at the appropriate controller panels.
- G. Scheduling. An editor for an enterprise-wide scheduling application shall be provided. Provide a method by which a system operator can make permanent changes to one or many building schedules without the need to repeat any steps. The system shall provide temporary changes to one or more schedules at one or more building locations.

1. Manual Control and Override. Provide a means of manually controlling analog and binary output points.
 2. Air System Equipment Coordination. Provide a control application and user interface pages that summarize the monitoring and control functions that group together and coordinates the operation of air handling equipment and associated VAV boxes as specified in the sequence of operations. For each air system, status pages shall include:
 - a) System mode of the air handling system
 - b) Listing and assignment of the associated air handler and VAV boxes
 - c) AHU supply air cooling and heating setpoints
 - d) AHU minimum, maximum and nominal static pressure setpoints
 - e) VAV box minimum and maximum flow
- H. Provide software configuration tools [installed on operator PCs and/or Portable Operator's Terminals as designated] to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.
- I. Mobil Access & Web Interface compatibility
1. Provide access to an Apple Application from the Apple Store to view/modify schedules & setpoints remotely
 2. System shall be Safari compliant and shall be fully functional on Apple iPads, iPhones and other Safari devices
- J. Provide one Apple iPad with 64GB Memory, WYFY and Cellular capability for the owner to remotely view/modify system parameters.
- K. Portable Operator's Terminal. Furnish [1] Portable Operator's Terminal [including software configuration tools] that shall be capable of accessing all system data This device may be connected to any point on the system internetwork or may be connected directly to any controller for programming, set-up, and troubleshooting.
1. 1.7 GHz Intel Pentium Processor
 2. 512 MB RAM
 3. 40 Gigabyte Hard File
 4. 24X CD ROM Drive
 5. Windows XP Professional operating system
 6. 14" color display with minimum 1024 x 768 resolution

2.4 APPLICATION AND CONTROL SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at operator workstations served web-based user interface pages.
- B. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, and optimal start actions. When a group of objects are scheduled together, provide the capability to define advances and delays for each member.
- C. Optimal Start. The scheduling application shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
- D. Demand Limiting. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.
 - 1. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
 - 2. Control system shall be capable of demand limiting by resetting HVAC system setpoints to reduce load while maintaining a widened band of comfort control in the space.
 - 3. Input capability shall also be provided for an end-of-billing period indication.
- E. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.
- F. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The setpoint shall optionally be chosen to be a reset schedule.
- G. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.
- H. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.

- I. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.
- J. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.
- K. Demand Control Ventilation
1. The AHU outdoor-air damper shall be controlled to deliver required outdoor airflow at all load conditions. The outdoor airflow setpoint shall be determined according to ASHRAE Standard 62-2001, Equation 6-1 [or ASHRAE Standard 62.1-2004, Equation 6-8 and Appendix A]The actual outdoor airflow shall be sensed at the outdoor air intake.
 2. The BAS shall include a time-of-day schedule to indicate whether a zone is normally occupied or unoccupied. When the schedule indicates that the zone is normally unoccupied, the required outdoor airflow for the zone shall be zero. When the schedule indicates that the zone is normally occupied, the required outdoor airflow for the zone shall equal the design outdoor airflow (based on design occupancy), unless the zone is equipped with an occupancy sensor and/or a carbon dioxide (CO₂) sensor.
 - a. For those zones equipped with an occupancy sensor, the required outdoor airflow for the zone shall be continuously determined based on whether people are present or not. When the occupancy sensor indicates that people are present in the zone, the required outdoor airflow shall equal the design outdoor airflow. When the occupancy sensor indicates that no people are present in the zone, the required outdoor airflow shall equal the “occupied standby” outdoor airflow.
 - b. For those zones equipped with a CO₂ sensor, the required outdoor airflow for the zone shall be continuously calculated using the measured CO₂concentration as an indicator of the current per-person ventilation rate.
 3. The required outdoor-air fraction shall be continuously calculated for each VAV terminal zone. Outdoor-air fraction is defined as the current required outdoor airflow for the zone divided by the current primary airflow to the zone.
 4. The BAS shall regularly determine the highest zone outdoor-air fraction, sum the outdoor airflow requirements for all VAV zones, and sum the current primary airflows for all VAV zones to determine the total system primary airflow. This information shall be used in Equation 6-1 of ASHRAE Standard 62-2001 [or Equation 6-8 and Appendix A of ASHRAE Standard 62.1-2004] to calculate the minimum required outdoor airflow for the system. This minimum outdoor airflow setpoint shall be recalculated every 15 minutes (adj).
 5. The VAV Air System shall not request a higher percentage of outdoor air than the AHU is able to provide. This Ventilation Ratio Limit (adj.)of the AHU is dependent on the capacity of the AHU and the current outdoor air temperature and humidity conditions.
 6. Prior to final system acceptance, a contractor shall provide a trend log of actual system operation to the engineer and owner. Operating conditions to be logged include: highest zone outdoor-air fraction, total system primary airflow, calculated outdoor airflow setpoint for the system, and the actual measured outdoor airflow. These conditions must be logged at 15-minute intervals over a typical 48-hour period.
- L. Duct Static Pressure Optimization

1. The building automation system (BAS) shall continuously monitor the damper position of all VAV terminal units. The discharge duct static pressure shall be sensed directly at the discharge of each air handler. The sensor must be mounted in a non-turbulent location.
2. When any VAV damper is more than 75% (adj.) open, the supply fan discharge duct static pressure setpoint shall be reset upward by 0.1 in W.C. (adj.), at a frequency of 15 minutes (adj.), until no damper is more than 75% open or the static pressure setpoint has reset upward to the system maximum duct static pressure setpoint or the AHU variable-frequency drive is at the maximum speed setting.
3. When all VAV dampers are less than 65% (adj.) open, the supply fan discharge duct static pressure setpoint shall be reset downward by 0.1 in W.C.(adj.), at a frequency of 15 minutes (adj.), until at least one damper is more than 65% open or the static pressure setpoint has reset downward to the system minimum duct static pressure setpoint or the AHU variable-frequency drive is at the minimum speed setting.
4. The control bands, setpoint increment values, setpoint decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.
5. The BAS shall have the capability to allow the operator to exclude “problem” zones that should not be considered when determining the optimized setpoint.
6. The BAS shall also read the status of the supply air static pressure sensor and display the active duct static pressure reading on the status screen.
7. The BAS shall have the ability to identify, and display to the user, the VAV box that serves the Critical Zone (that is, the zone with the most wide-open VAV damper). This information shall update dynamically as the location of the Critical Zone changes based on building load, and duct static pressure setpoint optimization control.
8. During the commissioning process, the controls contractor shall demonstrate the performance of fan pressure optimization program report with associated balance parameters.

M. The building automation system shall provide the ability to automatically commission and calibrate the VAV Air System. The following tests shall be performed, at a minimum:

1. Calibration of the air valve / damper
2. Verification of air flow through the VAV box
3. Verification of local reheat performance for Hydronic heating
4. The building automation system (BAS) shall provide the ability to initiate the auto-commissioning /auto-calibration command directly from the user interface. Special service tools shall not be required.
5. The BAS shall provide the ability to stagger the auto-commissioning /auto-calibration sequence for groups of VAV boxes to allow the sequence to be performed during occupied hours, if necessary.
6. An auto-commissioning report for the VAV Air System shall be generated that contains the

results of the auto-commissioning / auto-calibration tests. This report shall contain, at a minimum, the following information for each VAV box in the system:

- a) Name of VAV box
- b) Date and time the VAV box was tested
- c) Presence of any alarms
- d) Space temperature and setpoint
- e) Active airflow (in CFM)
- f) Air valve / damper position when the VAV box reaches 40% of the maximum cooling airflow setpoint
- g) Air valve / damper position when the VAV box reaches 100% of the maximum cooling airflow setpoint

2.5 BUILDING GLOBAL CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, standalone; microprocessor based Building Controllers to manage the global strategies described in System software section.
 - 2. The Building Controller shall be UL 864 UUKL Certified for use in Smoke control systems. BUILDING CONTROLLERS THAT ARE NOT UL 864 CERTIFIED SHALL BE STRICTLY PROHIBITED.
 - 3. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 4. The controller shall provide a communications port for connection of the Portable Operators Terminal.
 - 5. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 6. Controllers that perform scheduling shall have a real time clock.
 - 7. Data shall be shared between networked Building Controllers.
 - 8. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
 - 9. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a) Assume a predetermined failure mode.
 - b) Generate an alarm notification.
 - c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d) Automatically reset the Building Controller to return to a normal operating mode.

- A. Communications. Each Building Controller shall reside on the enterprise-wide network, which is same high-speed network as the central server and PC workstations. The enterprise-wide network will be provided by the owner and supports the Internet Protocol (IP). Local connections of the Building Controller shall be on ISO 8802-3 (Ethernet). *Each Building Controller shall support BACnet IP, BACnet MSTP & LON Protocols simultaneously. Building Controllers that cannot support both BACnet & LON protocols are strictly prohibited.*
- B. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0° C to 50° C [32° F to 120° F].
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.
- D. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage.
- F. Building Controller Operator Display. Each building controller shall include an operator display allowing the user to perform basic daily operations tasks on the building automation system. At a minimum this operator display shall:
1. Be installed on the building controller and require no additional power source.
 2. Consist of a one-quarter VGA touch screen with 320 X 240-pixel resolution. The brightness and the contrast of the backlit touch screen shall be adjustable to allow for easy reading of information on the screen.
 3. Be capable of having unique user identification and passwords that can be programmed to limit access to the system and operator functions.
 4. Display the current state of an input/output point and equipment controller connected to the system.
 5. Give the operator the ability to override the current state of an output point or HVAC equipment controller connected to the building controller.
 6. Allow the operator to modify the start and stop times of any time-of-day schedule within the system.
 7. Provide a visual indication that a system alarm exists and allow for an optional audible alarm annunciation.
 8. Provide the ability to view and acknowledge alarms that are annunciated at that building controller.
 9. Allow the operator to view custom graphical displays with dynamic status information.
 10. Automatically update displayed system information every 10 seconds.

2.6 CUSTOM APPLICATION CONTROLLERS

- A. Provide Custom Application Controllers as needed to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 2. Custom Application Controllers shall be UL 864 UUKL Certified for use in Smoke control systems. CUSTOM APPLICATION CONTROLLERS THAT ARE NOT UL 864 CERTIFIED SHALL BE STRICTLY PROHIBITED.
 - 3. Controllers that perform scheduling shall have a real time clock.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.
- B. Controller hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0° C to 50° C [32° F to 120° F].
 - 2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° C to 70° C [-40° F to 158° F].
- C. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.
- D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.7 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Application Specific Controllers shall be UL 864 UUKL Certified for use in Smoke control systems. APPLICATION SPECIFIC CONTROLLERS THAT ARE NOT UL 864 CERTIFIED SHALL BE STRICTLY PROHIBITED.
- C. Environment. The hardware shall be suitable for the anticipated ambient conditions.
1. Controller used in conditioned ambient spaces shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0° C to 50° C [32° F to 120° F].
 2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° C to 65° C [-40° F to 150° F].
- D. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- E. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- F. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.
- G. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

2.8 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 VDC or a 4-20 mA signal as required to provide proper control of the output device.

2.9 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 - 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 - 2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
 - 3. Damper shaft bearings shall be as recommended by manufacturer for application.
 - 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 - 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
 - 6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electric damper/valve actuators.
 - 1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 - 2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 - 3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.

4. Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range.
5. 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 capacity shall have a manual crank for this purpose.
6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

a) Water Valves:

- i. Two-way: 150% of total system (pump) head.
- ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

3. Water Valves:

a) Belimo ePIV valves for all chilled water control valves.

- a. Chilled Water Control Valves
 - i. Acceptable Manufacturers
 1. Manufactured, brand labeled, or distributed by:
 - a. BELIMO AIRCONTROLS (USA), INC.
 - b. NEPTRONICS
 - c. FLOW CONTROL INDUSTRIES
 - ii. Control Valves: factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
 - iii. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional (except as noted).
 - iv. Pressure independent control Valves
 1. NPS 2 and Smaller: Forged brass body rated at no less than 360 PSI, stainless steel ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.
 2. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout

proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.

3. Accuracy: The control valves shall accurately control the flow from 0 to 100% rated flow with an operating pressure differential range of 5 to 50 PSI differential across the valve with a valve body flow accuracy of +/- 5% total assembly.
4. Flow Characteristics Selectable: Equal percentage or linear flow.
5. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are not acceptable.
6. The manufacturer shall provide a published commissioning procedure following the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB).
7. A wet calibrated electronic flow meter shall provide dynamic feedback to measure flow and verify performance.
8. The control valve shall require no maintenance and shall not include replaceable cartridges.

E. Binary Temperature Devices

1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
5. *The space temperature, setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The setpoint will be selectable utilizing buttons.*

G. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170°F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

H. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 mA output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 mA output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

I. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

J. Carbon Dioxide (CO₂) Sensors

1. Carbon Dioxide sensors shall measure CO₂ in PPM in a range of 0-2000 ppm. Accuracy shall be $\pm 3\%$ of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

K. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified.
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.

4. Current sensing relays may be used for flow sensing or terminal devices.

L. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

M. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0° C and 50° C.
4. Unit shall be UL recognized.

N. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

O. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3- EXECUTION

3.1 SECTION INCLUDES:

1. Examination
2. Protection
3. General Workmanship
4. Field Quality Control
5. Central Server Installation
6. Wiring
7. Fiber Optic Cable
8. Installation of Sensors
9. Flow Switch Installation
10. Actuators
11. Warning Labels
12. Identification of Hardware and Wiring
13. Controllers
14. Programming
15. Cleaning
16. Training
17. Acceptance

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.4 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.5 CENTRAL SERVER INSTALLATION

- A. The system installer shall perform complete installation and configuration of the following:
 - 1. Server hardware
 - 2. Server operating system
 - 3. Server database software
 - 4. Server application software

3.6 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Division 16/26 of these specifications. Where the requirements of this section differ with those in Division 16/26, the requirements of this section shall take precedence.
- B. All 120VAC Power to control panels, equipment and ancillary devices shall be provided and installed by Division 16/26.
- C. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- D. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- F. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- H. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- I. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.

- L. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- M. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- N. Adhere to Division 16/26 requirements for installation of raceway.
- O. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- P. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.7 FIBER OPTIC CABLE SYSTEM

- A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacture's specifications.
- C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.8 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.9 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Install and adjust flow switch in accordance with manufacturers' instructions.
- C. Assure correct flow direction and alignment.
- D. Mount in horizontal piping - flow switch on top of the pipe.

3.10 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
 - 1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.11 WARNING LABELS

- A. Affix labels on each starter and equipment automatically controlled through the DDC System. Warning label shall indicate the following:

CAUTION

*This equipment is operating under automatic control and may start or stop at any time without warning.
Switch disconnect to "Off" position before servicing.*

- B. Affix labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Labels shall indicate the following:

CAUTION

*This equipment is fed from more than one power source with separate disconnects.
Disconnect all power sources before servicing.*

1.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1-cm (1/2") letters on nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.13 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of [15%] spare I/O point capacity for each point type found at each location. If input points are not universal, [15%] of each type is required. If outputs are not universal, [15%] of each type is required. A minimum of one spare is required for each type of point used.
1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.14 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory in building controllers free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
 - 1. Enhanced Graphics. Provide graphics for each major piece of equipment and floor plan in the building as indicated in the graphics section.
 - 2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.
- E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.15 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.

- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING

- A. Provide a minimum of 2 classroom training sessions, 4 hours each, throughout the contract period for personnel designated by the Owner.
- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.
- C. Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:
 - 1. Day-to-day Operators
 - 2. Advanced Operators
 - 3. System Managers/Administrators
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.

3.17 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

PART 4: SEQUENCE OF OPERATIONS

- 4.1 Refer to the mechanical plans for the associated sequences of operations, flow diagrams & points list for this project.

END OF SECTION

SECTION 15990
TESTING, ADJUSTING AND BALANCING

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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. CTI: Cooling Tower Institute.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.

- B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
- E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1.
- D. Examine Architect's and Engineer's 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 equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.

- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.
- P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.

- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust- air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

- a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- C. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum design airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum design airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units being tested at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to design airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at design flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 HYDRONIC SYSTEMS' BALANCING PROCEDURES

- A. Determine water flow at pumps. Use the following procedures, except for positive- displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow- pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.
- E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over design flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
 - 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 FLOW VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Systems installed with pressure independent control valves shall not require hydronic systembalancing.

- B. Systems installed with pressure independent valves shall require verification of flow for 25% of the total installed product. Exact locations of tested product to be coordinated with the design engineer.

3.10 PRIMARY-SECONDARY HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating if high-efficiency motor.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of design flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator water entering and leaving temperatures, pressure drop, and water flow.
 - 2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by the chiller manufacturer.
 - 3. Power factor if factory-installed instrumentation is furnished for measuring kW.
 - 4. The kW input if factory-installed instrumentation is furnished for measuring kW.
 - 5. Capacity: Calculate in tons of cooling.
 - 6. Air-Cooled Chillers: Verify condenser-fan rotation and record fan data, including number of fans and entering- and leaving-air temperatures.

3.13 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.14 HEAT-TRANSFER COILS

- A. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperatures at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kW at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

3.15 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure outside-air, wet- and dry-bulb temperatures.

3.16 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.17 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.18 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 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 testing, adjusting, and balancing Agent who certifies the report.
 - 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
- 11. Nomenclature sheets for each item of equipment.
- 12. Data for terminal units, including manufacturer, type size, and fittings.
- 13. Notes to explain why certain final data in the body of reports vary from design values.
- 14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - 1. Quantities of outside, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
- F. Mounted Air-Handling Unit Test Reports: For roof mounted air-handling units with coils, include the following:
 - 1. Unit Data: Include the following:
 - 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 (mm), and bore.
 - i. Number of belts, make, and size.
 - j. Number of filters, type, and size.
 - 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.

3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Preheat coil static-pressure differential in inches wg (Pa).
 - f. Cooling coil static-pressure differential in inches wg (Pa).
 - g. Heating coil static-pressure differential in inches wg (Pa).
 - h. Outside airflow in cfm (L/s).
 - i. Return airflow in cfm (L/s).
 - j. Outside-air damper position.
 - k. Return-air damper position.
- G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central- station air-handling units, include the following:
 1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 2. Test Data: Include design and actual values for the following:
 - a. Heat output in Btuh (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For exhaust fans, include the following:
 1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.

- b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Number of belts, make, and size.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Air-Terminal-Device Reports: For terminal units, include the following:
- 1. Unit Data: Include the following:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Area served.
 - d. Air-terminal-device make.
 - e. Air-terminal-device number from system diagram.
 - f. Air-terminal-device type and model number.
 - g. Air-terminal-device size.
 - 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Space temperature in deg F (deg C).
- J. Packaged Chiller Reports: For each chiller, include the following:
- 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Make and model number.
 - c. Manufacturer's serial number.
 - d. Refrigerant type and capacity in gal. (L).
 - e. Starter type and size.
 - f. Starter thermal protection size.
 - 2. Condenser Test Data: Include design and actual values for the following:
 - a. Refrigerant pressure in psig (kPa).
 - b. Refrigerant temperature in deg F (deg C).
 - c. Entering-water temperature in deg F (deg C).
 - d. Leaving-water temperature in deg F (deg C).
 - e. Entering-water pressure in feet of head or psig (kPa).
 - f. Water pressure differential in feet of head or psig (kPa).

3. Evaporator Test Reports: Include design and actual values for the following:
 - a. Refrigerant pressure in psig (kPa).
 - b. Refrigerant temperature in deg F (deg C).
 - c. Entering-water temperature in deg F (deg C).
 - d. Leaving-water temperature in deg F (deg C).
 - e. Entering-water pressure in feet of head or psig (kPa).
 - f. Water pressure differential in feet of head or psig (kPa).
4. Compressor Test Data: Include design and actual values for the following:
 - a. Make and model number.
 - b. Manufacturer's serial number.
 - c. Suction pressure in psig (kPa).
 - d. Suction temperature in deg F (deg C).
 - e. Discharge pressure in psig (kPa).
 - f. Discharge temperature in deg F (deg C).
 - g. Oil pressure in psig (kPa).
 - h. Oil temperature in deg F (deg C).
 - i. Voltage at each connection.
 - j. Amperage for each phase.
 - k. The kW input.
 - l. Crankcase heater kW.
 - m. Chilled water control set point in deg F (deg C).
 - n. Condenser water control set point in deg F (deg C).
 - o. Refrigerant low-pressure-cutoff set point in psig (kPa).
 - p. Refrigerant high-pressure-cutoff set point in psig (kPa).
5. Refrigerant Test Data: Include design and actual values for the following:
 - a. Oil level.
 - b. Refrigerant level.
 - c. Relief valve setting in psig (kPa).
 - d. Unloader set points in psig (kPa).
 - e. Percentage of cylinders unloaded.
 - f. Bearing temperatures in deg F (deg C).
 - g. Vane position.
 - h. Low-temperature-cutoff set point in deg F (deg C).
- K. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:
 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Manufacturer's compressor serial numbers.
 - e. Compressor make.
 - f. Compressor model and serial numbers.
 - g. Refrigerant weight in lb (kg).

2. Test Data: Include design and actual values for the following:
 - a. Entering-air, dry-bulb temperature in deg F (deg C).
 - b. Leaving-air, dry-bulb temperature in deg F (deg C).
 - c. Control settings.
 - d. Unloader set points.
 - e. Low-pressure-cutout set point in psig (kPa).
 - f. High-pressure-cutout set point in psig (kPa).
 - g. Suction pressure in psig (kPa).
 - h. Suction temperature in deg F (deg C).
 - i. Condenser refrigerant pressure in psig (kPa).
 - j. Condenser refrigerant temperature in deg F (deg C).
 - k. Oil pressure in psig (kPa).
 - l. Oil temperature in deg F (deg C).
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. The kW input.
 - p. Number of fans.

- L. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches (mm).
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.

 2. Test Data: Include design and actual values for the following:
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches (mm).
 - d. Full-open flow rate in gpm (L/s).
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm (L/s).

- j. Voltage at each connection.
- k. Amperage for each phase.

3.19 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 16010
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 15 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. General Scope of Work:
 - 1. Providing new panels, feeders, conduits, electrical meter, disconnect, combination starter/disconnect, fire alarm, rough-in for telephone and data system, intercom system, and new light fixtures.

1.4 COORDINATION

- A. All electrical work shall be done under sub-contract to a General Contractor. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
- B. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- C. 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.
- D. Fully coordinate with mechanical contractor for providing power to mechanical equipment.

1.5 UTILITIES

- 1. Coordinate with power company and provide conduit, and trenching from transformer to power source. Coordinate with 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.

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.

1.7

SUBMITTALS

1. To expedite the submittal process more efficiently, do not piece-meal the submittals. Submit entire electrical in a bound enclosure. This will eliminate delays in the submittal process. Unbound submittals shall be returned without review. Submit 10 copies minimum.

END OF SECTION

SECTION 16020
BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Division 1 Specification Sections and all relevant documents shall form a part of this Division of the Specifications, and shall be incorporated in this Section and each Division 16 Section hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Division. Certain specific paragraphs of said references may be referred to hereinafter in this Division. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
- B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Division shall not be used as a basis for a request for additional compensation.
- C. The specific features and details for other portions of the work related to the construction in progress or to the adjacent building shall be determined by examination at the site.

1.2 SCOPE OF WORK

- A. The requirements contained in this Section apply to all work performed under Division 16 of these Specifications.
- B. The work covered by this Division of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
- C. Refer to other Divisions of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Division of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section, even though this Contractor may be technically described as a Subcontractor, or an authorized representative.
- B. If the Contractor, engaged to execute a portion of the work, employs a Subcontractor to perform some of that work, he shall be completely responsible for the proper execution of this Subcontractor's work, in full conformity with the Contract Documents.

1.4 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall be responsible for all work of every description in connection with this Division of the Specifications. The Contractor shall specifically and distinctly assume, and does so assume, all risk for damage or injury from whatever cause to property or person used or employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.
- B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, the Contractor shall make report of such objections to the Owner's Representative, obtain proper approval and adjustment to the Contract,

and shall proceed with the work.

1.5 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Division, complete for operation, unless specifically noted to the contrary.
- B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Division of the Specifications be similarly furnished, installed and connected under this Division, whether or not a phrase as described in the preceding paragraph has been actually included.
- C. Whenever the words "Owner's Representative" occurs, it is intended to refer to the Architect, Engineer and/or specific Owner's Representative responsible for or capable of providing the necessary direction pertaining to the referenced issue.

1.6 ORDINANCES, PERMITS AND CODES

- A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.
- B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.
- C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.
- D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.
- E. The work shall be in accordance with, but shall not be limited to, the requirements of:
 - 1 National Fire Protection Association
 - 2 National Electrical Code
 - 3 National Safety Code
 - 4 State of Texas Safety Code
 - 5. Local City Building Codes
 - 6. State of Texas Building Codes
- F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.7 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

- A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.
- B. Materials, equipment and devices furnished under this Division of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.
- C. In describing the various materials, equipment and devices, in general each item will be described

singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.

- D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

1.8 QUALITY ASSURANCE

- A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.
- B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.9 REFERENCE STANDARDS

- A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
- B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of noncompliance deficiencies with the Contractor bearing all costs.
- C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

AABM	-	American Association of Battery Manufacturers
ADA	-	American's with Disabilities Act
AIA	-	American Institute of Architects
ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
CBM	-	Certified Ballast Manufacturers Association
ETL	-	Electrical Testing Laboratories
FM	-	Factory Mutual
ICEA	-	Insulated Cable Engineers Associated
IEEE	-	Institute of Electrical and Electronic Engineers
IES	-	Illuminating Engineering Society
IRI	-	Industrial Risk Insurance
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code
NETA	-	National Electrical Testing Association

NFPA - National Fire Protection Association
UL - Underwriters Laboratories
□□□□□

1.10 DRAWINGS AND SPECIFICATIONS

- A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:
 - 1 The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
 - 2 The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.
- B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:
 - 1 If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated for a complete operable system. Contractor is responsible to notifying the Architect and Engineer. In the event of this type of disagreement, the resolution shall be determined by the Owner's Representative. The contractor shall assume for an operable system at the most expensive combination as per the latest National Electrical Code. The contractor shall review all drawings and specifications prior to bid date.
 - 2 The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Owner's Representative immediately, prior to bid date.
 - 3 In general, if there is conflict between the Drawings and Specifications, the Drawings shall govern the Specifications.
 - 4 Where the Specifications do not fully agree with schedules on the Drawings, the schedules shall govern. Actual numerical dimensions indicated on the Drawings govern scale measurements and large scale details govern small scale drawings.
 - 5 Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.
 - 6 Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.
- C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.
- D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Owner's Representative for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.
- E. Review the construction details of the building(s) as illustrated on the Drawings of the other portions of the work, i.e., architectural, structural, civil, landscape, etc., and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.
- F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to

elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. In cooperation with other Contractors, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner's Representative, without additional cost to the Owner.

- G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory operating installations. Prepare installation drawings as required for all critical areas illustrating the installation of the work in this Division as related to the work of all other Divisions and correct all interferences with the other portions of the work or with the building structures before the work proceeds.
- H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Division.

1.11 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 1 of the Specifications.
- B. Process product data and shop drawings to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
- C. Submittals shall be provided for review and approval on all systems, equipment, devices and materials proposed for use on this project. Submittals shall include, but not be limited to, the following:
 - 1 Lighting and Appliance Panelboards
 - 2 Disconnect Switches
 - 3 Circuit Breakers and Fuses
 - 4 Materials: conduit, conductors, connectors, supports, etc.
 - 5 Lighting Fixtures, Lamps and Control Systems/Devices
 - 6 Wiring Devices
 - 7 Transformers
 - 8 Distribution Panelboards
 - 9 Motor Control Center
 - 10 As indicated on each submittal section
- D. The product data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
- F. Assemble submittals on related items procured from a single manufacturer in bound brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
- G. Prepare shop drawings whenever equipment proposed varies in physical size and arrangement

from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner's Representative. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.

- H. The Contractor shall sign the submittal as an indication of compliance with the Contract Documents. If there are any deviations from the Contract Documents, he shall so indicate on the submittal. Any deviations not so indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

1.12 SUBSTITUTIONS

- A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
- B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
- C. Manufacturers not listed will be considered for substitution prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum seven (7) business days prior to bid with each sub-paragraph noted with the comment, "compliance", "deviation", "alternate" or "not applicable". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
 - 1 By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
 - 2 By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
 - 3 By noting the term "alternate" or "A", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.
 - 4 By noting the term "not applicable" or "N/A", it shall be understood that the specified item is not applicable to the project.
- D. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.
- E. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner's Representative, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
- F. The Owner's Representative reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an

evaluation of the item may be better made by visual inspection.

- G. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

1.13 INSTALLATION DRAWINGS

- A. Prepare installation drawings for coordinating the work of this Division with the work of other Divisions, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.
- B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Owner's Representative for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION

- A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.
- B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.
- C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 INSPECTION OF SITE

- A. The accompanying drawings do not indicate existing installations other than to identify modifications of and extensions thereto. The Contractor shall visit the site, inspect the installations and ascertain the conditions to be met and the work to be performed. Failure to comply with this shall not constitute ground for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work under this Division.
- B. Review construction details of the adjacent building presently under construction during the site inspection and include all work required to modify the existing installations and install new materials, comprising a part of the installation. Review all construction details of the new building as illustrated on the drawings and be guided thereby.

1.16 WARRANTY

- A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Owner's Representative for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.
- B. The Contractor shall furnish to the Owner's Representative for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.17 OPERATION PRIOR TO ACCEPTANCE

- A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.18 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers and/or technicians acceptable to the Owner's Representative to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.19 SCHEDULE AND SEQUENCE OF WORK

- A. The Contractor shall meet and cooperate with the Owner and Owner's Representative to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

1.20 INSTALLATION INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.
- B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Owner's Representative for transmission to the Owner.

1.21 EQUIPMENT INSTALLATION

- A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.
- B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.
- C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

1.22 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads shall be provided for all floor mounted equipment, unless noted or required otherwise.
- B. All pads shall be not less than 3-1/2" high and extend a maximum 3" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Pads shall be poured in forms built of new dressed lumber with corners chamfered using sheet metal or triangular wood strips nailed to the form. Use 6 x 6 No. 3 mesh for reinforcing. Install heavy duty adjustable anchor bolts, set in the form and positioned using templates, prior to pouring concrete. After the

equipment is set on the pad, the equipment shall be aligned, leveled and fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.

- C. Perform all concrete work specified to be provided under this Division in strict accordance with the applicable provisions of Division 3, CONCRETE.

1.23 SLEEVES

- A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
- B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
- C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked and filled with an asphalt-base compound to insure a waterproof penetration. Jute twine caulking shall not be used due to susceptibility to termite infestation.

1.24 ESCUTCHEONS

- A. In each finished space, provide a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 ACCESS PANELS

- A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.
- B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.26 SEALING OF PENETRATIONS

- A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:
 - 1 Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
 - 2 Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
 - 3 Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
- B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.
- C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.
- D. In addition to the Dow Corning products, equal products by Spec Seal Firestop Products, 3M Fire Barrier or CS240 Firestop are acceptable.

1.27 PROTECTION OF APPARATUS

- A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Owner's Representative will be sufficient cause for the rejection of the pieces of apparatus in question.
- B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Division of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.
- C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.28 INSTALLATION OF CONTROL AND OPERATING DEVICES

- A. The highest operable part of controls (light switches, dimmer switches, emergency power off devices, etc.), receptacles (electrical and communications) and other operable devices shall be 48" above finish floor. The lowest operable part shall be no less than 15" above finished floor. For purposes of uniformity, unless noted otherwise, the top of a device shall be maximum 48" AFF and the bottom of a device shall be minimum 15" AFF. Refer to the electrical symbols list on the Drawings for specific requirements.
- B. Visual alarm appliances shall be placed 80" above finished floor (the highest floor level within a space) or 6" below the ceiling, whichever is lower.

1.29 INSTALLATION AND CONNECTION OF OTHER DIVISION'S EQUIPMENT

- A. Verify the electrical requirements of all equipment furnished under other Divisions, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

- A. The location of power, data and telephone outlets, wall switches and other related devices may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

- A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the completion of the job, the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.
- B. After the installation is complete, and before the equipment is energized, clean the interior and exterior of all equipment thoroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material removed. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with a lemon-oil rag after all other cleaning is complete.
- C. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

- A. The Contractor shall obtain at his own expense a complete set of blue-line prints on which to keep

an accurate record of the installation of all materials, equipment and devices covered by the Contract. The Contractor shall record up to date information at least once a week and retain the set of prints on site for periodic review by the Architect/Engineer. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. If the Contractor prepared large scale installation drawings of electrical rooms, conduit routing, busduct, routing, etc., these drawings or reproducible sepia's therefrom shall be revised as required to accurately illustrate the actual installation. All conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location.

- B. Upon anticipated completion of the job, obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these record drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. This information shall be delivered prior to final acceptance.
- C. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Owner's Representative for review and subsequent delivery to the Owner prior to final acceptance.
 - 1 Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.
 - 2 Approved lighting fixture brochures, wiring diagrams and control diagrams.
 - 3 Copies of approved submittals and shop drawings.
 - 4 Operating instructions and recommended maintenance procedures for major apparatus.
 - 5 Copies of all other data and/or drawings required during construction.
 - 6 Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
 - 7 Tag charts and diagrams hereinbefore specified.

1.33 FINAL OBSERVATION

- A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.
- B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Owner's Representative to make a final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete equipment bases.
 - 7. Electrical demolition.
 - 8. Cutting and patching for electrical construction.
 - 9. Touchup painting.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Type 3R enclosure.
 - 2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity, minimum.

2.2 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.3 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
- F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Install conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

- 5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
- G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- H. Install telephone and signal system raceways, 2-inch trade size (DN53) and smaller, in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
- J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
 - 1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
 - 3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue and yellow.
 - c. Telecommunication System: Green and yellow.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
- G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.
 - 2. Phase B: Red.
 - 3. Phase C: Blue.
 - 4. Neutral: White.
 - 5. Ground: Green.
- H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: BROWN.
 - 2. Phase B: ORANGE.
 - 3. Phase C: YELLOW.
 - 4. Neutral: White with a colored stripe or gray.
 - 5. Ground: Green.

- I. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- J. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.6 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.7 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

3.8 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete bases.

7. Electrical demolition.
 8. Cutting and patching for electrical construction.
 9. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
 5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.11 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 16055
SITE ELECTRICAL

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of all site electrical work.
- B. The site electrical work shall include, but not be limited to, the furnishing and installation of necessary materials and making arrangements for:
 - 1. The connection of electrical and telephone utilities.
 - 2. Underground conduit.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 1 for products specified under PARTS 2 PRODUCTS.

1.4 REFERENCE STANDARDS

- A. National Electrical Code (NEC), Article 300
- B. Service installation standards of the serving utility company(s).

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE

- A. Coordination: The location of the service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the electrical service. Contractor shall coordinate with the Power Company for all requirements prior to bid date. Contractor shall include all cost to for Utility Company to extend service to project site bid.
- B. Materials: Provide materials in accordance with other Sections of these Specifications.

2.2 COMMUNICATION SERVICE

- A. Coordination: The location of the telephone, cable, and internet service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the telephone, cable and internet services. Contractor shall coordinate with the Telephone , cable, and internet company for all requirements prior to bid date. Contractor is responsible to coordinate with utility companies.
- B. Materials: Provide materials in accordance with other sections of this specification.

PART 3 EXECUTION

3.1 GENERAL

- A. Underground installation of more than one conduit shall be in a duct arrangement as indicated. All conduits shall be laid so joints are staggered. All bends and stub-ups shall be rigid steel.
- B. Pour a red colored concrete envelope 3" thick over utility service, emergency generator and fire pump conduits. Where conduits cross a driveway, road or parking area, reinforcing rods shall be installed.
- C. Perform excavation, shoring, backfilling and concrete work in connection with electrical work in accordance with other Divisions of the Specifications.
- D. All conduit shall be sloped away from the building to negate water entering the building through the conduit system.

3.2 UTILITIES

- A. The locations, elevations and voltage of electrical lines and the location of the telephone lines included within the area of this work are indicated on the Drawings or in the Specifications in accordance with information received by the Architect/Engineer and Owner.
- B. The Contractor shall examine the site and shall verify, to his own satisfaction, the location and elevation of all utilities, and shall adequately inform himself as to their relation to the work.
- C. Existing utility lines not indicated but encountered during construction shall be protected, relocated or capped as directed by the Architect/Engineer. All precautions shall be exercised to prevent damage to existing lines not shown, but should work become necessary, it must be authorized prior to execution except in an emergency situation.
- D. Before beginning excavations of any nature whatsoever, the Contractor shall make an attempt to locate all underground utilities of every nature occurring within the bounds of the area to be excavated. The Contractor shall then proceed with caution in his excavation work so that no utility shall be damaged with a resultant loss of service.
- E. Should a damage result to any utility through the Contractor's negligence or failure to comply with the above directive, he shall be liable for such damage and for all expense incurred in the expeditious repair or replacement of such damaged utilities.
- F. Repair of damaged utilities shall be to a condition equal to or better than the adjacent undamaged portion of such utility and to the complete satisfaction of the Architect/Engineer and Owner.

END OF SECTION

SECTION 16060
GROUNDING AND BONDING

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 grounding and bonding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 2 Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical rods.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following:
 - 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.

1.4 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.
 - 1. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Erico Inc.; Electrical Products Group.
 - g. Framatome Connectors/Burndy Electrical.
 - h. Galvan Industries, Inc.
 - i. Hastings Fiber Glass Products, Inc.
 - j. Ideal Industries, Inc.
 - k. ILSCO.
 - l. Kearney/Cooper Power Systems.
 - m. Korns: C. C. Korns Co.; Division of Robroy Industries.
 - n. Lightning Master Corp.
 - o. Lyncole XIT Grounding.
 - p. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - q. Raco, Inc.; Division of Hubbell.
 - r. Robbins Lightning, Inc.
 - s. Salisbury: W. H. Salisbury & Co.
 - t. Superior Grounding Systems, Inc.

- u. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: stranded, unless otherwise indicated.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- H. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 - 1. No. 4 AWG minimum, soft-drawn copper conductor.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.

1. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
- B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- C. Test Wells: Provide handholes as specified in Division 2 Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
- G. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
- D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - E. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
 - F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding 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. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 - I. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
 - J. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
 - K. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 - L. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: 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.
 1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding 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.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
- B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
- C. Testing: Perform the following field quality-control testing:
 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.
 3. Provide 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.

- a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification sections, apply to work covered by this Section.
- B. Comply with Division 16 Sections, as applicable. Refer to other Divisions for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of electrical identification, including related accessories.
- B. Provide electrical identification for the following:
 - 1. Panelboards, motor starters, contactors, disconnect switches, circuit breakers and other electrical equipment with nameplate identifying the item of equipment and the equipment serving the same.
 - 2. Raceways, junction boxes and pull boxes.
 - 1. Label each panelboard index indicating the room #s to the related circuit. Also add the index sheet in a laminated white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
 - 3. Wiring devices.
 - 4. Wiring.
 - 5. Three phase motor rotation.

1.3 SUBMITTALS

- A. Submit product data in accordance with Division 1 for products specified under PART 2 - PRODUCTS.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- B. Brady
- C. Panduit
- D. Thomas & Betts
- E. Seton

2.2 IDENTIFICATION

- A. Nameplates
 - 1. Nameplates shall be black engraved surface on white core for normal power circuits and red engraved surface on white core for emergency power circuits.
 - 2. Provide for each distribution panelboard, branch circuit panelboard, transformer and any other similar equipment furnished under this Division identification as to its given name, voltage and origination of service. Examples are

as follows:

'LB'	'HD'
480Y/277V	480Y/277V
FED FROM 'MDP'	FED FROM 'MDP'

'RDP'	'TX-R'
208Y/120V	300 KVA, 480V to
FED FROM TX-R	208Y/120V
FED FROM 'MDP'	

3. Provide for each motor starter enclosure, circuit breaker enclosure, disconnect switch and any other similar equipment furnished under this Division, identification as to the specific load that it serves and the origination of service. Examples are as follows:

'CH-1'	'AHU-1'
FED FROM 'MDP'	FED FROM 'DPA'

4. Provide for each feeder protective device in each distribution panelboard and any other similar equipment furnished under this Division, identification as to the specific load that it serves.
5. Nameplates shall be laminated, white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.

B. Junction Boxes and Pull Boxes

1. Identification shall be with a black permanent marking pen on the top of 4" x 4" junction box covers or on the back of an outlet box cover plate identifying the branch circuits and systems within the conduit. Pull boxes shall be provided with a nameplate stating voltage and system served.

C. Wiring Device Wall Plates

1. On the back side of wiring device wall plates identify with a black permanent marking pen the panelboard and branch circuit number the device is served from.

D. Wire Markers

1. Wire markers for identification of wiring shall be self-adhesive type having letters and numerals indicating serving equipment and feeder or branch circuit number.

F. Rotation Tags

1. Rotation tags shall be brass or aluminum securely attached to equipment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surfaces to receive labels or nameplates shall be carefully prepared in accordance with the manufacturer's instructions and recommendations.

3.2 NAMEPLATES

- A. Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this Division.

3.3 WIRE MARKERS

- A. Wire markers shall be applied to each conductor or cable within panelboards, motor starter enclosures, circuit breaker enclosures, disconnect switches, cabinets, junction boxes, pull boxes, and other similar equipment identifying the serving equipment and feeder or branch circuit from which the conductors originate.

END OF SECTION

SECTION 16120
BUILDING WIRE AND CABLE

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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co.

- b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.
2. Connectors for Wires and Cables:
- a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.
 - e. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 3.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- D. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
- E. Conductor Material: Copper.
- F. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- G. Plenum rated cable for all cables above the ceiling.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Feeders: Type 75C insulation THHN/THWN, in raceway.
- C. Fire-Pump Feeder: Type MI, 3-conductor.
- D. Branch Circuits: Type THHN/THWN, in raceway.
- E. Fire Alarm Circuits: Type THHN/THWN, in raceway.
- F. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- G. Class 2 Control Circuits: Type THHN/THWN, in raceway.
- H. Equipment or any device rated 100 amperes or less, conductor shall be rated 60C as per National Electrical Code.
- I. Equipment or any device rated over 100 amperes, conductor shall be rated 75C as per National Electrical Code.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Remove existing wires from raceway before pulling in new wires and cables.
- C. Pull Conductors: 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, that 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 Division 16 Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."
- H. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.

- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. 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.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 16130
RACEWAYS AND BOXES

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 1. Raceways include the following:

- a. RMC.
 - b. IMC.
 - c. PVC externally coated, rigid steel conduits.
 - d. PVC externally coated, IMC.
 - e. EMT.
 - f. FMC.
 - g. LFMC.
 - h. LFNC.
 - i. RNC.
 - j. ENT.
 - k. Wireways.
 - l. Surface raceways.

- 2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.

- B. Related Sections include the following:

1. Division 16 Section "Basic Electrical Materials and Methods" for raceways and box supports.
2. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RMC: Rigid metal conduit.
- H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflex Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
 - 2. Nonmetallic Conduit and Tubing:
 - a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.

- k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
- 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
- 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw type.
- E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
- B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

- C. LFNC: UL 1660.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Screw – cover type flanged-and-gasketed type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.

2.6 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.7 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.

2. Concealed: Rigid steel.
 3. Underground, Single Run: RNC.
 4. Underground, Grouped: RNC.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 6. Boxes and Enclosures: NEMA 250, Type 3R .
- B. Indoors: Use the following wiring methods:
1. Exposed: EMT.
 2. Concealed: EMT.
 3. Underground, Single Run: RNC.
 4. Underground, Grouped: RNC
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum Raceway Size: 3/4-inch trade size (DN21).
- C. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- D. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom.
- F. Complete raceway installation before starting conductor installation.
- G. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- H. Use temporary closures to prevent foreign matter from entering raceways.
- I. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

- J. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- K. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- L. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- M. Raceways Embedded in Slabs (Must be indicated on drawings to be embedded. Please notify Engineer if required but not shown): Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- O. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- P. Tighten set screws of threadless fittings with suitable tools.
- Q. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- R. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

- T. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- U. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- V. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- W. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- X. 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 a nonmetallic sleeve.
- Y. Do not install aluminum conduits embedded in or in contact with concrete.
- Z. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- AA. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.
- BB. Set floor boxes level and adjust to finished floor surface.
- CC. Set floor boxes level and trim after installation to fit flush to finished floor surface.

DD. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

EE. **NO PVC CONDUIT ALLOWED ABOVE THE CEILING OR IN THE A/C RETURN PLENUM. PROVIDE RIGID CONDUIT. Verify all MEP documents.**

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 16139
CABLE TRAYS

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. Wire-basket cable trays.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cabletray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
 - 5. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. **Delegated Design:** Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

2.3 WIRE-BASKET CABLE TRAYS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Cablofil/Legrande.
2. Cooper B-Line, Inc.
3. Wiremaid Products Division; Vutec Corporation.

- B. Description:

Configuration: Wires are formed into a standard 2-by-4-inch (50-by-100-mm) wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.

Materials: High-strength-steel longitudinal wires with no bends.

Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.

Sizes:

Straight sections shall be furnished in standard 118-inch (3000-mm) lengths.

Wire-Basket Depth: 1-inch (25-mm) usable loading depth by 4 inches (100 mm) 12 inches (300 mm) wide.

Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.

Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.4 MATERIALS AND FINISHES

- A. Steel, zinc plated.
- B. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

- A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

- A. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- B. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- C. Remove burrs and sharp edges from cable trays.
- D. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- E. Support bus assembly to prevent twisting from eccentric loading.
- F. Support wire-basket cable trays with trapeze hangers brackets.
- G. Support trapeze hangers for wire-basket trays with 1/4-inch- (6-mm) diameter rods.
- H. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- I. Make changes in direction and elevation using manufacturer's recommended fittings.
- J. Make cable tray connections using manufacturer's recommended fittings.
- K. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- L. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations off fire and smoke barriers.
- M. Install cable trays with enough workspace to permit access for installing cables.
- N. Install barriers to separate cables of different systems, such as, communications, and data processing.
- O. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for

grounding purposes or with listed bonding jumpers.

- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800mm).

3.4 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

**END OF
SECTION**

SECTION 16140
WIRING DEVICES

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 receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. GFI: Ground-fault circuit interrupter.
- B. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

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.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- B. Coordinate with pool contractor for special receptacles.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

- a. Bryant Electric, Inc.
- b. Eagle Electric Manufacturing Co., Inc.
- c. GE Company; GE Wiring Devices.
- d. Hubbell, Inc.; Wiring Devices Div.
- e. Killark Electric Manufacturing Co.
- f. Leviton Manufacturing Co., Inc.
- g. Pass & Seymour/Legrand; Wiring Devices Div.
- h. Pyle-National, Inc.; an Amphenol Co.

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
- B. Special Receptacles for NEMA configuration refer to Manufacturer specs.
- C. GFI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter. Device shall have an indicator light.
- D. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap. **Device shall be white finish with the orange symbol.**
 1. Devices: Listed and labeled as isolated-ground receptacles.
 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 SWITCHES

A. General

1. Switches shall be toggle or decorative rocker type as indicated herein.. The body of the switch shall be made of an arc-resistant thermoset material. All toggle switch handles shall be constructed of a thermoplastic material. All rocker switch handles shall be constructed of a thermoset material. All wall switches shall be of the quiet AC type.
1. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
2. Switch color shall be white unless noted otherwise. Coordinate with Architect.

B. Specification Grade

1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
1. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
 2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide with "on/off" switch; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads. Dimmer to be sized per circuit load.

2.4 WALL PLATES(All wall plates)

- A. For all single and combination types match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
 3. Material for Unfinished Spaces: stainless steel.

2.5 FLOOR SERVICE FITTINGS

- A. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
- B. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

- F. Protect devices and assemblies during painting.
- G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
- B. Comply with Division 16 Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification sections, apply to work covered by this Section.
- B. Comply with Division 16 Sections, as applicable. Refer to other Division for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of supporting devices, including related systems and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- B. Unistrut Corp.
- C. B-Line Systems, Inc.
- D. Midland Ross-Kindorf

2.2 MATERIALS

- A. Suspension Hangers

1.1 Suspension hangers for individual conduit runs shall be zinc plated formed steel type.

- B. Vertical Supports

1.1 Malleable iron one hole pipe straps shall be used for vertical runs.

- C. Clamps

1.1 Beam clamps shall be used for bar joists and beams.

- D. Anti-Vibration Hangers

1.1 Anti-vibration hangers shall be combination type having a double deflection neoprene element in series with a steel coil spring; double deflection of 0.30"; steel coil spring shall be selected from a 1" static deflection series with a minimum additional travel to solid of ½"; spring diameters shall be large enough to permit 15 degree angular misalignment of the rod connecting the hanger to the ceiling support without rubbing the hanger box.

2.3 Light Fixture Hangers

- A. Refer to Section 16500

Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hangers

- 1 Approved hangers and stiff leg supports shall be installed in quantity and size as required to carry the weight of raceway and contents and shall be arranged to prevent vibration transmission to the building and allow for raceway movement.
- 2 Hangers shall be supported by means of uncoated solid steel rods which are threaded to allow vertical adjustments. Lock nuts shall be provided in sufficient number and location to lock all rod adjustments permanently at the adjusted height. Two lock nuts shall be used unless the nut tightens against a threaded socket. Minimum rod diameters shall be as follows:

NOMINAL CONDUIT SIZE	ROD DIAMETER
1/2" through 2"	1/4"
2-1/2" through 3"	3/8"
4" and 5"	1/2"
- 3 Hanger spacing shall be as required for proper and adequate support raceway, but in no case shall be less than one hanger per 8'-0" of raceway length except that conduit less than 1" diameter shall be supported at least every 6'-0".
- 4 Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.
- 5 Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

B. Supports

- 1 Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.
- 2 Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.
- 3 Ceiling mounted lighting fixtures shall be supported from the building structure at two opposite corners. The Contractor shall provide fixture hangers to properly interface with the ceiling system.
- 4 Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.
- 5 Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.
- 6 Support of hangers from concrete tees shall be by means of sufficient quantity of angle iron brackets attached with after set expansion shields and bolts.

END OF SECTION

SECTION 16425
SWITCHBOARD

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification Sections apply to Work covered by this Section.
- B. Comply with other Division 16 Sections, as applicable. Refer to other Divisions for coordination of the Work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of switchboard indicated, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 1 for products specified under PART 2 - PRODUCTS.
- B. Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of horizontal bus bars per phase, neutral and ground; one-line diagrams; equipment schedule; and switchboard instrument details.

1.4 REFERENCE STANDARDS

- A. Switchboards and overcurrent protection devices referenced herein shall be designed and manufactured according to the latest version of the following standards:
 - 1. ANSI/NFPA 70 - National Electrical Code (NEC).
 - 2. ANSI/IEEE C12.1 - Code for Electricity Metering.
 - 3. ANSI C39.1 - Electrical Analog Indicating Instruments.
 - 4. ANSI C57.13 - Instrument Transformers.
 - 5. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 6. NEMA KS 1 - Enclosed Switches.
 - 7. NEMA PB 2 - Deadfront Distribution Switchboards.
 - 8. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
 - 9. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
 - 10. UL 50 - Cabinets and Boxes

11. UL 98 - Enclosed and Dead Front Switches
12. UL 489 - Molded Case Circuit Breakers
13. UL 891 - Dead-Front Switchboards
14. UL 943 - Ground Fault Circuit Interrupters
15. UL 977 - Fused Power Circuit Devices
16. Federal Specification W-C-375B/Gen - Circuit breakers, molded case, branch circuit and service.
17. Federal Specification W-C-870 - Fuseholders (for plug and enclosed cartridge fuses)
18. Federal Specification W-S-865 - Enclosed Knife Switch

1.5 QUALITY ASSURANCE

- A. Furnish products listed and classified by Underwriters Laboratories Incorporated and in accordance with the reference standards previously indicated.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- B. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.
- C. Inspect and report concealed damage to carrier within their required time period for repair or replacement.
- D. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.
- E. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 MAINTENANCE MATERIALS

- A. Provide one (1) set of installation and maintenance instructions with each switchboard. Instructions shall be easily identified and affixed within the incoming or main section of the line-up.

1.9 WARRANTY

1. A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a period of one (1) year from date of final acceptance by the Owner. Manufacturer shall provide additional twelve months warranty with a qualified factory-trained manufacturer's representative with the assistance of the start-up of the equipment specified under this section for a total of twenty-four months of warranty.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Squire-D
- B. Eaton.

2.2 GENERAL

- A. Short Circuit Current Rating: Switchboards shall have a minimum short circuit current rating as indicated on the Drawings in RMS symmetrical amperes at the maximum AC voltage indicated.
- B. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- C. Switchboard enclosure shall be NEMA Type 1 - general purpose.
 1. Align switchboard sections at front and rear.
 2. Switchboards shall be of deadfront construction.
 3. Switchboard frames shall be of formed UL gauge steel rigidly bolted together to support all cover plates, bussing and component devices during shipment and installation.
 4. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
 5. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduit.
 6. Switchboard enclosures shall be painted on all exterior surfaces. The paint finish shall be an ANSI standard medium light gray.
 7. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
 8. Top and bottom conduit areas shall be clearly indicated on shop drawings.
- D. Provide engraved laminated nameplates for each switchboard and each overcurrent protective device in accordance with Section 16195.
- E. Bus composition shall be Copper. The switchboard bussing shall be based on 1000A per square inch. The phase and neutral (for 4-wire systems) through-bus shall have an ampacity as indicated. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions. No tapered bus allowed.

- F. Bus connections shall be bolted with Grade 5 bolts and conical spring washers.
- G. Ground bus shall be copper and shall be sized per NFPA 70 and UL 891 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided as previously indicated.
- H. Accessibility shall be only from the front of the switchboard.

2.3 INCOMING MAIN SECTION DEVICES

A. Main Circuit Breaker

- 1.
 - a. Main circuit breaker shall be fixed, individually mounted.
 - b. Provide ground fault protection for main breaker.
 - c. Power terminals shall be provided to accommodate either cable or bolted bus connections.

2.4 DISTRIBUTION DEVICES

A. Feeder thermal magnetic Circuit Breakers

- 1.
 - a. Group mounted 100A through 1200A.
 - 1) Branch circuit breaker(s) shall be group mounted on a common pan or rail assembly.
 - 2) Circuit breaker(s) shall be mounted in the switchboard to permit installation, maintenance and testing without reaching over line side bussing.
 - 3) The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide isolation to the entire length of bus.
 - 4) There shall be one (1) continuous bus bar per phase; each bus bar having a pair of exposed longitudinal edge portions providing non-specific mounting means for branch circuit breaker(s).
 - 5) The entire interleaved assembly shall be contained between the two (2) U-shaped steel channels, permanently secured to a galvanized mounting pan by tamper-resistant fasteners.
 - 6) Circuit breaker(s) shall not require additional external mounting hardware. Circuit breaker(s) shall be held in the mounted position by a self-contained bracket secured to the mounting pan by fasteners. Each individual circuit breaker shall be capable of being mounted independently. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other without means of a common bracket.
 - 7) Line side circuit breaker connections shall be jaw type or bolted bus connection.
- 8). Terminations

- a. All lugs shall be UL Listed to accept solid and/or stranded copper conductors only. Lugs shall be suitable for 75°C rated wire. Lug body shall be bolted in place.
- b. All circuit breakers shall be UL Listed to accept field installable/ removable mechanical type lugs.
- c. All circuit breakers shall be suitable for bus connection.

2.6 ELECTRONIC POWER MONITORING

A. General

- 1. Provide solid-state, multi-function power monitoring system/device with digital display.
- 2. Provide a display to monitor main circuit breaker only, with internet option.

B. Power Monitor(equal to Cutler Hammer # IQ260 series)

- 1. The electronic power monitor shall accept inputs from industry standard instrument transformers (120VAC secondary PT's and 5A secondary CT's).
- 2. All setup parameters required by the power monitors shall be stored in nonvolatile memory (no battery backup) and retained in the event of a control power interruption.
- 3. The power monitor shall also maintain in nonvolatile memory a maximum and minimum value for each of the instantaneous values reported as well as the time and date of the highest peak for all of the peak demand readings.
- 4. The following instantaneous readings shall be reported by the power monitor:
 - a. Current, per phase RMS $\pm 1.0\%$
 - b. Current, 3-phase average RMS $\pm 1.0\%$
 - c. Current, apparent RMS $\pm 1.0\%$
 - d. Voltage, phase-to-phase & phase-to-neutral $\pm 1.0\%$ e. Power factor, per phase $\pm 2.0\%$
 - e. Power factor, 3-phase total $\pm 2.0\%$
 - f. Real power, 3-phase total $\pm 2.0\%$
 - g. Reactive power, 3-phase total $\pm 2.0\%$
 - h. Apparent power, 3-phase total $\pm 2.0\%$
 - i. Frequency $\pm 0.5\%$
- 5. The following demand readings shall be reported by the power monitor:

- a. Average demand current, per phase
 - b. Peak demand current, per phase
 - c. Average demand, real power
 - d. Peak demand, real power
- 6. The following energy readings shall be reported by the power monitor:
 - a. Accumulated energy
 - b. Accumulated reactive energy
- C. Power Monitor Installation
 - 1. The power monitor shall be installed by the switchboard manufacturer.
- D. Certification Description
 - 1. All equipment included as part of the power monitoring shall be UL Listed or UL recognized.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine area to receive switchboard to provide adequate clearance for switchboard installation.
- B. Check that concrete housekeeping pads are level and free of irregularities.
- C. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install switchboard in accordance with manufacturer's written instructions and the NEC.

3.3 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure, using a megger, the insulation resistance of each bus section phase to phase and phase to ground for one minute each, at minimum test voltage of 1000 volts DC; minimum acceptable value for insulation resistance is 1 megohms. Refer to manufacturer's written instructions for specific testing procedures.
- C. Check tightness of accessible bolted bus joints using calibrated torque wrench per manufacturer's recommended torque values.
- D. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of 5 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein. Manufacturer shall provide additional twelve months warranty with a qualified factory-trained

manufacturer's representative with the assistance of the start-up of the equipment specified under this section for a total of twenty-four months of warranty.

3.4 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturers specifications.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values as directed by the Engineer.

3.5 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16440
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of disconnect switches, including all related systems and accessories.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 1 for products specified under PART 2 - PRODUCTS.
- B. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.
- C. Provide designations for each disconnect. RE: to section 16075.

1.4 REFERENCE STANDARDS

- A. Switches shall be manufactured in accordance with the following standards:
 - 1. UL 98 - Enclosed and Dead Front Switches
 - 2. NEMA KS1 - Enclosed Switches
 - 3. NEMA 250 - Enclosures for Electrical Equipment

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Square-D
- B. Eaton

2.2 GENERAL

- A. Switches shall be heavy duty type.

2.3 SWITCH INTERIOR

- A. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.

- C. Lugs shall be copper and front removable and UL listed for 60°C or 75°C conductors 30-100 ampere, 75°C conductors 200 ampere and up.
- D. Current carrying parts shall be plated to resist corrosion.
- E. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
- F. Switches shall have provisions for a field installable electrical interlock.

2.4 SWITCH MECHANISM

- A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- B. The operating handle shall be an integral part of the box, not the cover.
- C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
- D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
- E. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.5 SWITCH ENCLOSURES

- A. Switch covers shall be attached with welded pin-type hinges (Type 1) or top-hinged, attached with removable screws and securable in the open position (Type 3R).
- B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R).
- C. The enclosure shall have ON and OFF markings stamped into the cover.
- D. The operating handle shall be provided with a dual colored, red/black position indication.
- E. Switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.
- G. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
- H. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
- I. Type 4x shall be stainless steel enclosure with no knockouts. Supply watertight hubs.

2.6 SWITCH RATINGS

- A. Switches shall be horsepower rated.

- B. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses 30-600 ampere employing appropriate fuse rejection schemes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated shown or not shown.
- B. Install fuses in fusible disconnect switches.

END OF SECTION

SECTION 16442
PANELBOARDS

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 load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Sections include the following:
 - 1. Division 16 Section "Fuses."

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.

- d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
 - 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.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," 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.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

- A. Keys: [SIX] 6 spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Square-D
 - b. Eaton

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- J. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
- K. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- L. Split Bus: Vertical buses divided into individual vertical sections.
- M. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

- N. Gutter Barrier: Arrange to isolate individual panel sections.
- O. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- P. Feed-through Lugs: Copper mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, 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 Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- E. Install filler plates in unused spaces.
- F. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods" [Electrical Identification].
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

- B. 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. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16475
FUSES

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. Fuses.

1.3 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 fuse type specified.
- C. Field test reports indicating and interpreting test results.
- D. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
 - 1. The 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.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. Cooper Industries, Inc.; Bussmann Div.
 - 2. Eagle Electric Mfg. Co., Inc.
 - 3. Ferraz Corp.
 - 4. General Electric Co.; Wiring Devices Div.
 - 5. Gould Shawmut.
 - 6. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
 - 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
 - 4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK1, time delay.
- B. Other Branch Circuits: Class RK5, non-time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
- B. Install spare fuse cabinet where indicated.

3.4 IDENTIFICATION

- A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

SECTION 16511
INTERIOR LIGHTING

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 interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 3. Emergency lighting unit battery and charger.
 - 4. LED lights
 - 5. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- D. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.

- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED FIXTURES

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:
 - 1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - 2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
 - 3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
 - 4. Color Rendering Index (CRI) of 82 at a minimum.
 - 5. Color temperature [3500] <Insert value> K, unless otherwise indicated.
 - 6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
 - 7. Fixture efficacy of 60 Lumens/Watt, minimum.
 - 8. 5 year luminaire warranty, minimum.
 - 9. Photometry must comply with IESNA LM-79.
 - 10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
 - 11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
- C. Technical Requirements
 - 1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
 - 2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
 - 3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.

4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

D. Thermal Management

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.4 LED EXIT SIGNS

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
- G. Voltage: Multi-voltage (120 – 277V).

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when 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, and battery is automatically recharged and floated on charger.

2.6 LAMPS

- A. ALL LED – NO LAMPS

2.7 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid for support.
 1. Install a minimum of two ceiling support system wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
 3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- C. Suspended Fixture Support: As follows:
 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3.2 CONNECTIONS

- A. 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 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
 1. Verify normal operation of each fixture after installation.

2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.
4. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 16515
NETWORK LIGHTING CONTROLS
ACUITY BRANDS-NLIGHT NETWORK CONTROLS

PART 1 – GENERAL

1.0 SECTION INCLUDES

- A. Network lighting control system and components:
 - 1. Touch panel controls
 - 2. Lighting management panels
 - 3. Lighting management modules
 - 4. Low voltage wall stations
 - 5. Power interfaces
 - 6. Wired sensors

1.1. RELATED DOCUMENTS

- A. Section 262726 Wiring Devices
- B. Section 260923 Lighting Control Devices
- C. Section 260943.13 Digital-Network Lighting Controls
- D. Section 260943.16 Addressable Fixture Lighting Control
- E. Section 260943.19 Wireless Network Lighting Controls
- F. Section 265113 Interior Lighting Fixtures

1.2. SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of “dimming lights to off”
- C. All system devices shall be networked together, enabling digital communication between devices, and shall be individually addressed.
- D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.3 SUBMITTALS

- A. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
- B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- C. Other Diagrams – as needed for special operation or interaction with other system(s)
- D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- E. Hardware and Software Operation Manuals
- F. Other operational descriptions as needed

1.4 PROJECT CLOSEOUT DOCUMENTATION

- A. Provide a factory published manual
 - 1. Warranty
 - 2. Technical support contact

3. Electronic manual on manufacturer's website for free download

1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures are permanently installed
- C. Equipment is protected from dust, debris and moisture

1.7 WARRANTY

- A. Five (5) year 100% parts replacement

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user
- B. Provide free telephone technical support

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable: Acuity Brands Lighting, Inc. – System: nLight by Acuity Controls
- B. Basis of controls design Manufacturer: **Acuity Brands, One Lithonia Way, Conyers GA 30012, www.acuitycontrols.com**
- C. Substitutions: Not Permitted {Under Division 1 }:
 1. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
 2. Proposed substitute products must be documented with a line by line compliance review

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see *Networked LED Luminaire* section).
- D. Intelligent lighting control devices shall communicate digitally, require <7 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.

- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, controls enabled luminaires, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.
- N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.
- O. WiFi-enabled devices shall be capable of current monitoring
- P. WiFi-enabled devices shall utilize WPA2 AES encryption
- Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks
- R. WiFi-enabled devices shall have two local RJ-45 port for communicating with non WiFi-enabled system devices
- S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.
- T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- U. Devices located in different lighting zones shall be able to communicate occupancy, photocell (non-dimming), and switch information via either the wired or WiFi backbone.
- V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space. Note: Operating modes should be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - 2. Manual-On / Auto-Off (also called Semi-Automatic)

- Pushing a switch will turn lights on.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
3. Manual-On to Auto-On/Auto-Off
 - Pushing a switch will turn lights on.
 - After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
 4. Auto-to-Override On
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zone lighting then goes into an override on state for a set amount of time, or until the next time event returns the lighting to an auto-off style of control.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
 5. Manual-to-Override On
 - Pushing a switch will turn lights on.
 - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - Sequence can be reset via scheduled (ex. daily each morning) events.
 6. Auto On / Predictive Off
 - Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - Pressing the switch will turn the lights off and a short “exit timer” begins. After the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
 7. Multi-Level Operation (multiple lighting levels per manual button press)
 - Operating mode designed specifically for bi-level applications.
 - Enables the user to cycle through up to four potential on/off/dim low/dim high lighting states using only a single button.
 - Eliminates user confusion as to which of two buttons controls which load
 - Three different transition sequences are available in order to comply with energy codes or user preference).
 - Mode available as a setting on all devices that have single manual on/off switch (ex. nPODM, nPODM-DX, nWSX LV).
 - Depending on the sequence selected, every button push steps through relay/dimming states according to below table
 - In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

		State of load after each pushbutton press			
MLO Mode		1st Press	2nd Press	3rd Press	4th Press
2-State (Alternating)	Load A	On	Off	Off	-
	Load B	Off	On	Off	-
2-State (Both On, A First)	Load A	On	On	Off	-
	Load B	Off	On	Off	-
2-State (Both On, B First)	Load A	Off	On	Off	-
	Load B	On	On	Off	-
3-State	Load A	On	Off	On	Off
	Load B	Off	On	On	Off
A and B On ¹	Load A	On	Off	-	-
	Load B	On	Off	-	-
A On Only ¹	Load A	On	Off	-	-
	Load B	Off	Off	-	-
A and B On & Dim High ¹	Load A	High	Off	-	-
	Load B	High	Off	-	-
Dim Low /High	Load A	Low	High	Off	-
Dim Low / High	Load A	High	Low	Off	-

NOTE 1: Modes for use only when Auto-On state of Load A & B is different than first MLO state

- W. A taskbar style desktop application shall be available for personal lighting control.
- X. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- Y. Control software shall enable logging of system performance data and presenting this information in a web-based format and downloadable to .CSV files.
- Z. Control software shall enable integration with a BMS via BACnet IP, although a hardware BACnet IP integration solution is also available.
- AA. System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Control module (gateway)
 - 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
 - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - 3. Control device shall have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices(up to 128 per port).
 - 4. Device shall automatically detect all devices downstream of it.
 - 5. Device shall have a standard and astronomical internal time clock.
 - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
 - 7. Device shall have a USB port

8. Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
9. Device shall be capable of using a dedicated static or DHCP assigned IP address.
10. Network Control Gateway device shall be the following nLight model Series:

nGWY2

B. Networked system occupancy sensors

1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections

shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

17. Wall switch sensors shall have optional features for photocell/daylight override, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.
20. Wall switch sensors shall be the following nLight model numbers, with device color and optional features as specified:
 - nWSX** (PIR, 1 Relay)
 - nWSX PDT** (Dual Tech, 1 Relay)
 - nWSX LV** (PIR, No Relay)
 - nWSX PDT LV** (Dual Tech, No Relay)
 - nWSX LV NL** (PIR w/ Night Light, No Relay)
 - nWSX PDT LV NL** (Dual Tech w/ Night Light, No Relay)
 - nWSX LV DX** (PIR, No Relay, Raise/Lower Dim Ctrl)
 - nWSX PDT LV DX** (Dual Tech, No Relay, Raise/Lower Dim Ctrl)
21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
23. Embedded sensors shall have an optional photocell
24. Embedded sensors shall be the following nLight model number:
 - nES 7** (PIR, No Relay)
 - nES 7 ADCX** (PIR w/ Photocell, No Relay)
 - nES PDT 7** (Dual Technology, No Relay)
 - nES PDT 7 ADCX** (Dual Technology w/ Photocell, No Relay)
25. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
26. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
27. Sensors shall be the following nLight model numbers, with device options as specified:

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM(B) 9	1	-	Standard	PIR
nCM(B) 9 2P	2	-	Standard	PIR
nCM 9 RJB	1	-	Standard	PIR
nCM 9 2P RJB	2	-	Standard	PIR
nCM(B) PDT 9	1	-	Standard	Dual
nCM(B) PDT 9 2P	2	-	Standard	Dual
nCM PDT 9 RJB	1	-	Standard	Dual
nCM PDT 9 2P RJB	2	-	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM(B) 10 2P	2	-	Extended	PIR
nCM 10 RJB	1	-	Extended	PIR
nCM 10 2P RJB	2	-	Extended	PIR
nCM(B) PDT 10	1	-	Extended	Dual
nCM(B) PDT 10 2P	2	-	Extended	Dual
nCM PDT 10 RJB	1	-	Extended	Dual
nCM PDT 10 2P RJB	2	-	Extended	Dual
nRM 9	1	-	Standard	PIR
nRM PDT 9	1	-	Standard	Dual
nRM 10	1	-	Extended	PIR
nRM PDT 10	1	-	Extended	Dual
nRM 6	1	-	High Bay	PIR
nRM 50	1	-	Aisle Way	PIR
nWV 16	1	-	Wide View	PIR
nWV PDT 16	1	-	Wide View	Dual
nHW13	1	-	Hallway	PIR
nCM(B) 6	1	-	High Bay	PIR
nCM 6 RJB	1	-	High Bay	PIR

C. Networked system daylight (photocell and/or dimming) sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting.)
5. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
6. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
7. Sensor shall be the following nLight model numbers, with device options as specified:
 - nCM(B) PC (RJB)** (on/off)
 - nCM(B) PC DZ (RJB)** (on/off control, dual zone)
 - nCM(B) ADCX (RJB)** (remote automatic dimming control photocell)
 - nCM(B) ADCX DZ (RJB)** (remote automatic dimming control photocell, dual zone)
 - nRM PC** (on/off)
 - nRM PC DZ** (on/off, dual zone)
 - nRM ADCX** (remote automatic dimming control photocell)
 - nRM ADCX DZ** (remote automatic dimming control photocell, dual zone)
8. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
9. Embedded sensors shall be the following nLight model number:
 - nES ADCX** (Dimming Photocell)

D. Networked System Power (Relay) Packs

1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power Packs (Secondary) shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
12. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
13. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
14. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
15. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
16. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
17. Power (Relay) Packs and Supplies shall be the following nLight model numbers:
 - nPP16** (Power Pack w/ 16A relay)
 - nPP16 D** (Power Pack w/ 16A relay and 0-10VDC dimming output)
 - nPP16 WIFI** (Power Pack w/ 16A relay, WIFI enabled)
 - nEPP5 D** (Power Pack w/ 5A relay and 0-10VDC dimming output)
 - nSP16** (Secondary Pack w/ 16A relay)
 - nPP16 ER** (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)
 - nPP16 D ER** UL924 Listed Secondary Pack w/ 16A relay and 0-10VDC dimming output for switching/dimming emergency power circuits)
 - nSP5 PCD 2W** (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
 - nSP5 PCD 3W** (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)
 - nSP5 PCD MLV** (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)
 - nSP5 PCD ELV 120** (Secondary Pack w/ 4A relay and electronic low voltage dimming output)
 - nSP5 2P LVR** (Louver/Damper Control Pack)
 - nSHADE** (Pulse On/Off Control Pack)
 - nPP20 PL** (Secondary Pack w/ 20A relay for general purpose receptacle load)
 - nPS 80** (Auxiliary Bus Power Supply)
 - nPS 80 WIFI** (Auxiliary Bus Power Supply, WiFi enabled)
 - nAR 40** (Low voltage auxiliary relay pack)

E. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.

2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
8. Power (Relay) Packs and Supplies shall be the following nLight model numbers:
nPANEL 4 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)
nPANEL 2 480 (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs)

F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a 1/2" knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
5. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).
10. Auxiliary Input/Output Devices shall be the following nLight model numbers:
nIO D (I/O device with 0-10 dimming output)
nIO 1S or **nIO RLX** (I/O device with contact closure or 0-10VDC dimming input)
nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in **nIO PC KIT** only)
nIO X (Interface device for communicating with RS-232 enabled AV Touch Screens)

G. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device
2. Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter)
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)

4. Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG versions)
5. System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports "sleep mode"
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
8. Integrated control devices shall be the following nLight model series:

nIO LEDG (ER)

nIO EZ PH (ER)

nPS 80 EZ (ER)

nEPS 60 IO EZ

nEIO EZ LC (ER)

9. LED Luminaires shall be the following Acuity Brands LED fixtures, which come factory enabled with nLight devices:

Lithonia model families:

RTL(X)

TL(X)

VTL(X)

FSL(X)

ACL(X)

ALL(S)

AVL

BZL

GTL

SBS

IBL/IBH

PTN

LDN

DOM

WL

STL

Gotham model families:

EVO

Incito

Mark model families:

Slot 2/4/6

Fin

Veil

Whisper

Nol

SPR

Peerless model families:

Vellum

Mino

Round 2/4
Square
Origami
Bruno
Staple
Lightline
Lightedge
Ice tray
Cerra
Prima
Naro
Tulip
Envision
Aero
Enzo

H. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
3. All devices shall have two RJ-45 ports.
4. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
5. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
6. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
7. Devices with mechanical push-buttons shall be made available with custom button labeling
8. Devices with a single “on” button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
9. Wall switches & dimmers shall be the following nLight model numbers, with device options as specified:
 - nPODM** (single on/off, push-buttons, LED user feedback)
 - nPODM DX** (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
 - nPODM 2P** (dual on/off, push-buttons, LED user feedback)
 - nPODM 2P DX** (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
 - nPODM 4P** (quad on/off, push-buttons, LED user feedback)
 - nPODM 4P DX** (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

I. Networked System Graphic Wall Station

1. Device shall have a 3.5” full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
4. Device shall enable user supplied .jpg screen saver image to be uploaded.

5. Device shall surface mount to single-gang switch box.
6. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
7. Device shall have a micro-USB style connector for local computer connectivity.
8. Device shall have two RJ-45 ports for communication
9. Device shall be the following nLight model number:

nPOD GFX

J. Networked System Scene Controllers

1. Device shall have two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
3. Device shall recess into single-gang switch box and fit a standard GFI opening.
4. Devices shall provide LED user feedback.
5. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
6. All devices shall have two RJ-45 ports.
7. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
8. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
9. Device shall have LEDs indicating current selection.
10. Scene Selector device shall be the following nLight model number:

nPODM 2S (2 Scene, push-button)

nPODM 4S (4 Scene, push-button)

nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)

nPODM 2L (2 Adjustable Preset Levels, push-button, On/Off)

nPODM 2L AB (2 Scene, push-button, On/Off/High/Low)

nPODM 4L DX (4 Adjustable Preset Levels, push-button,
On/Off/Raise/Lower)

K. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
6. Communication Bridge devices shall be the following nLight model numbers:

nBRG 8 (8 Ports)

2.4. LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Specific device parameters (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device, with a system backup on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5. MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6. BMS COMPATIBILITY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software.
- B. BACnet IP connection shall also be available utilizing JACE-600 hardware unit.
- C. BACnet IP hardware shall be capable of supporting up to 1500 total devices across up to 5 total Gateways
- D. BACnet IP connection shall communicate information gathered by networked system to other building management systems.

- E. BACnet IP connection shall translate and forward lighting relay and other select control commands from BMS system to networked control devices via profiles stored in the system Gateway. All system devices shall be available for polling for devices status.
- F. BACnet IP hardware device shall be the following nLight model name:
nBACnet

2.7. SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An "Energy Scorecard" shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8. START-UP & SUPPORT FEATURES

- A. Pre-construction Jobsite Visit
 - a. Project electrical contractor/distributor shall contact Spectrum Lighting – San Antonio to schedule jobsite meeting prior to the beginning of the installation of the lighting control system. Purpose of the meeting is to review installation documentation provided by the system manufacturer and submittals. Discussion should include wiring conventions and specific wiring requirements. Installation of specific devices are also to be addressed.
 - b. Purpose is to review any questions regarding the installation of the lighting control system by the installing contractor.
 - c. Prior to commissioning Spectrum Lighting field service technical shall visit the jobsite to confirm progress and answer any additional questions. Commissioning date is to be confirmed at the time of this visit. Training agenda shall be provided to the contractor/distributor. Contractor/distributor shall confirm owner representative and specifying engineer attendance at lighting system demonstration and/or for training. Contractor/distributor shall provide to field service technician programming information as required for commissioning to include zone assignments, time schedules for operation, presets for all control stations, programming sequences for dynamic LED fixtures, emergency operation, blink warn, and system override. Programming information is required for system set-up and pre-commissioning.
- B. Lighting Control System Commissioning and Training
 - a. Prior to energizing the lighting control system, the following must be completed: No component of the lighting control system shall be energized prior to a factory certified field service engineer has approved the installation of the system by the project electrical contractor. Failure to have a factory certified field service technician approve the installation

and commission the system will relieve the manufacturer of the lighting control equipment of all responsibility relating to damaged parts or warranty. The electrical contractor/distributor shall contact Spectrum Lighting at least 3 weeks prior to the requested commissioning date to schedule a field service engineer to be at the jobsite. Request shall be in writing and shall include filled out commissioning request form and dated jobsite photos of the dimmer and/or relay panels.

- b. Lighting Control system is defined as the dimmer/relay panel(s) and all associated control stations and related accessories.
- c. The electrical contractor is responsible to install the entire lighting control system, all power feeders, all load wiring, and control wiring. Equipment shall be installed according to the manufacturer's instructions, contract documents, and national and local codes and regulations.
- d. Equipment shall be plumb and level to the finished floor. All components of the lighting control system shall be clean, free of dust and paint spatters. Components shall be unmarred or damaged. All cable shall be dressed, neatly routed, and labeled. All conduit shall be securely attached to the dimmer/relay panel.

C. Commissioning

- a. Each dimmer/relay panels shall be individually tested with the connected load as designed. Each dimmer/relay should be tested with its connected load as specified.
- b. Each dimmer/relay shall be tested by the electrical contractor (with a multi-meter) to confirm what voltage is being passed and to confirm that no voltage is being passed when the circuit is open.
- c. A representative of the owner shall be present to observe the testing/demonstration of the dimmer/relay panels. Each individual dimmer/relay panel shall be load tested with all circuits on while under load for a minimum of 1 hour.
- d. Where external devices are to be attached to the dimmer/relay panel including photocell, occupancy sensor, time clock, and/or control stations, operation of each device should be verified at the panel and specific circuits that are programmed to be controlled by the external device(s).
- e. Where control signals originate from the dimmer/relay panel for control of lighting fixtures, the control signal shall be tested by the electrical contractor to confirm that it is being delivered to each lighting fixture. Proper operation of the lighting fixtures shall be confirmed as part of the system testing/demonstration.

D. Training

- a. Training shall be provided for the owner's representative and contractor. Prior to commissioning owner's representative and electrical contractor/distributor shall acknowledge receipt of training agenda. Electrical contractor/distributor shall confirm that specifying engineer has been contacted and been invited to attend the system demonstration and/or training. All product and lighting control system documentation and operation's manuals shall be provided by electrical contractor/distributor at the time of training.
- b. Training is to include, but not be limited to: basic operation of lighting control system, set-up of system and control panels, operation of control stations, programming of system, basic debugging, and overall system testing. At completion of training session all in attendance shall sign the commissioning technician's field service report to confirm participation in the training session.
- c. Completed field service report shall be submitted to the electrical contractor/distributor and specifying engineer.

E. Follow-up Contact

- a. Approximately 90 days following the commissioning of the lighting control system Spectrum Lighting shall contact the electrical contractor/distributor to confirm that the system is

operating correctly and answer any operational questions that have come-up since commissioning.

F. Warranty Review and Follow-up Visit

- a. Approximately 300 days following commissioning of the lighting control system Spectrum Lighting shall contact the owner's representative who attended the system demonstration and training and electrical contractor/distributor to schedule a visit to the jobsite. Visit shall be scheduled so that testing of the lighting control system and related equipment can be conducted without disturbing normal operation of the jobsite. In attendance should be owner's representative and contractor.
- b. The lighting control system shall be demonstrated to confirm operation. All system programming shall be confirmed and when necessary adjusted to meet the set-up or current requirements. When programming needs to be adjusted the new system configuration files shall be forwarded by the field service technician to the system manufacturer, as required. Copies can be provided to owner's representative upon request. Any questions regarding operation of the system shall be addressed at this time.
- c. Any lighting control equipment that is not operating as defined by the specification shall be repaired or replaced at the discretion of the field service technician. Projected dates for completion of all changes will be included in the follow-up report. All system changes and updates shall be documented by the field service technician and provided in a written report to the owner's representative, contractor, and specifying engineer.
- d. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
- e. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- f. Once software is installed, system shall be able to auto-discover all system devices without requiring any further programming.
- g. All system devices shall be capable of being given user defined names.
- h. All devices within the network shall be able to have their firmware upgraded remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- i. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

END OF SECTION

SECTION 16521
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation, and connection of exterior fixtures, poles, and supports. The terms “lighting fixtures”, “fixture” and “luminaire” are used interchangeably.

1.2 RELATED WORK

- A. Section CAST-IN-PLACE CONCRETE.
- B. Section SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- C. Section REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- D. Section LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- E. Section GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- G. Section UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- H. Section LIGHTING CONTROLS: Controls for exterior lighting.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
 - b. Material and construction details, include information on housing and optics system.
 - c. Physical dimensions and description.
 - d. Wiring schematic and connection diagram.
 - e. Installation details.
 - f. Energy efficiency data.
 - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

- h. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
 - i. Submit site plan showing all exterior lighting fixtures with fixture tags consistent with Lighting Fixture Schedule as shown on drawings. Site plan shall show computer generated point-by-point illumination calculations. Include lamp lumen and light loss factors used in calculations.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
 - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the Contractor that the exterior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Aluminum Association Inc. (AA):
AAH35.1-06 Alloy and Temper Designation Systems for Aluminum
- C. American Association of State Highway and Transportation Officials (AASHTO):
32-LTS-6..... Structural Supports for Highway Signs, Luminaires and Traffic Signals
- D. American Concrete Institute (ACI):
318-05 Building Code Requirements for Structural Concrete
- E. American National Standards Institute (ANSI):
C81.61-09 Electrical Lamp Bases – Specifications for Bases (Caps) for Electric Lamps
- F. American Society for Testing and Materials (ASTM):
A123/A123M-12 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M-09..... Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B108-03a-08 Aluminum-Alloy Permanent Mold Castings
C1089-13 Spun Cast Prestressed Concrete Poles
- G. Federal Aviation Administration (FAA):
AC 70/7460-IK-07 Obstruction Lighting and Marking
AC 150/5345-43F-06 Obstruction Lighting Equipment
- H. Illuminating Engineering Society of North America (IESNA):
HB-9-00 Lighting Handbook
RP-8-05 Roadway Lighting
LM-52-03..... Photometric Measurements of Roadway Sign Installations
LM-72-10..... Directional Positioning of Photometric Data
LM-79-08..... Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

- LM-80-08 Approved Method for Measuring Lumen Maintenance of LED Light Sources
- TM-15-07 Backlight, Uplight and Glare (BUG) Ratings
- I. National Electrical Manufacturers Association (NEMA):
- C78.41-06 Electric Lamps – Guidelines for Low-Pressure Sodium Lamps
- C78.42-07 Electric Lamps – Guidelines for High-Pressure Sodium Lamps
- C78.43-07 Electric Lamps – Single-Ended Metal-Halide Lamps
- C78.1381-98 Electric Lamps – 70-Watt M85 Double-Ended Metal-Halide Lamps
- C82.4-02 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps
(Multiple-Supply Type)
- C136.3-05 For Roadway and Area Lighting Equipment – Luminaire Attachments
- C136.17-05 Roadway and Area Lighting Equipment – Enclosed Side-Mounted Luminaires for
Horizontal-Burning High-Intensity-Discharge Lamps – Mechanical
Interchangeability of Refractors
- ICS 2-00 (R2005) Controllers, Contactors and Overload Relays Rated 600 Volts
- ICS 6-93 (R2006) Enclosures
- J. National Fire Protection Association (NFPA):
- 70-11 National Electrical Code (NEC)
- K. Underwriters Laboratories, Inc. (UL):
- 496-08 Lampholders
- 773-95 Plug-In, Locking Type Photocontrols for Use with Area Lighting
- 773A-06 Nonindustrial Photoelectric Switches for Lighting Control
- 1029-94 High-Intensity-Discharge Lamp Ballasts
- 1598-08 Luminaires
- 8750-09 Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.6 DELIVERY, STORAGE, AND HANDLING

Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 305 mm (12 inches) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

Luminaires, materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.2 POLES

A. General:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.

2. The pole and arm assembly shall be designed for wind loading of (10 mph) minimum, as required by wind loading conditions at project site, with an additional 30% gust factor and supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.
3. Poles shall be //embedded// //anchor-bolt// type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear opening of 65 x 125 mm (2.5 x 5 inches). Handhole covers shall be secured by stainless steel captive screws.
4. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
5. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
6. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
7. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

B. Types:

1. Pole – refer to light fixture schedule.

2.3 FOUNDATIONS FOR POLES

- A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.
- C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 6 mm (0.25-inch) radius.
- E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- F. Prior to concrete pour, install electrode per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

2.4 LUMINAIRES

- A. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.
- B. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.

- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61-09 and UL 496-08.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.5 LAMPS

- F. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
 - 2. Correlated Color Temperature (CCT)://4000K//.
 - 3. Color Rendering Index (CRI): ≥ 85 .
 - 4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.//
- G. Mercury vapor lamps shall not be used.

2.6 LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40 degrees C (-40 degrees F).
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) volt.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.//

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Pole Foundations:
 - 1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.
 - 2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
 - 3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
 - 4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 9 mm (0.375-inch) inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.
- C. Install lamps in each luminaire.
- D. Adjust luminaires that require field adjustment or aiming.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

3.3 ACCEPTANCE CHECKS AND TESTS

Verify operation after installing luminaires and energizing circuits.

END OF SECTION

SECTION 16693
BRANCH CIRCUIT PANELBOARD POWER CONDITIONING SURGE PROTECTION DEVICE

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, apply to work covered by this Section.
- B. Comply with Division 16 Sections, as applicable. Refer to other Divisions for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a high-energy power conditioning surge protection device(s) at branch circuit panelboards where indicated on the Drawings. The device shall incorporate transient voltage surge suppression (TVSS) and high-frequency electrical line noise filtering. The device shall provide effective high energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line stabilization in ANSI/IEEE C62.41-2002 environments connected downstream from the facility's main overcurrent protective device. The device shall be connected in parallel with the facility's wiring system.
- B. The device shall be installed as an integral part or external of the panelboard, switchboard.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for products specified under PART 2 - PRODUCTS.
- B. Manufacturers' Product Data: Submit material specifications and installation data for products specified under PART 2 - PRODUCTS.
- C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.

- 1 Include electrical characteristics and ratings for the specified equipment.
- 2 Include wiring diagrams indicating the internal connections of the specified equipment within its enclosure.
- 3 Drawings shall be provided indicating device dimensions, weights, mounting provisions, connection details and wiring diagrams.
- 4 Documentation of the specified device UL 1449 3rd Edition voltage protection rating (VPR) and per mode surge current rating shall be included. All submittals without this documentation will be rejected.
- 5 The manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.

- D. Record Drawings

- 1 A complete set of manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

1.4 QUALITY ASSURANCE

- A. Industry Reference Standards and Publications: The device shall be designed, manufactured, tested and installed in compliance

with the latest editions of:

- 1 American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-2002 and C62.45-2002)
- 2 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
- 3 National Electrical Manufacturers Association (NEMA LS-1)
- 4 National Fire Protection Association (NFPA 70, National Electrical Code (NEC), 75 and 78)
- 5 Underwriters Laboratories UL 1449 Standard for Transient Voltage Surge Suppressors Surge Protection Devices and UL 1283 Standard for Electromagnetic Interference Filters.

- B. The device shall be UL listed under UL 1449 and UL 1283 complimentary listed.
- C. The device shall be warranted against defects in material and/or workmanship and any failure or end-of-life event including lighting for a minimum of TEN (10) years from the date of shipment.
 - D. The device shall be thoroughly factory-tested before shipment. Testing of the device shall include but not be limited to quality control checks, maximum continuous operating voltage (MCOV) check, and clamping voltage verification tests. The MCOV check shall consist of a minimum of one (1) hour burn-in at the applicable MCOV.

1.5 SYSTEM DESCRIPTION

A. Environmental Requirements

- 1 Storage Temperature: Storage temperature range shall be -40° to +85° C (-40° to +185° F).
- 2 Operating Temperature: Operating temperature range shall be -40° to +60° C (-40° to 140° F).
- 3 Relative Humidity: Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
- 4 Operating Altitude: The device shall be capable of operation in an altitude of 0 - 12,000 feet above sea level.
- 5 Audible Noise: The device shall not generate any audible noise.
- 6 Magnetic Fields: No appreciable magnetic fields shall be generated. The device shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.

B. Electrical Requirements

- 1 Device Operating Voltage: The nominal operating voltage and configuration shall be that of the switchgear, distribution panel, sub or branch panelboard. Maximum Continuous Operating Voltage (MCOV): The allowable maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 115% of the nominal operating voltage.
 - 2 Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.
 - 3 Protection Modes: The devices primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.
 - 4 Surge Current Capacity and Voltage Protection Rating: Unless specifically noted on the drawings and/or the schedules, the surge current capacity, and the voltage protection rating of the SPD shall be not less than listed on the following table.
- The above text gives you the option to request a specific surge current rating on the riser or panel schedules

Location	Per Mode Surge Current Rating	120/208vac 3 phase VPR	277/480vac 3 phase VPR
Switchgear	200,000 amps	900v	1200v
Distribution Panel	150,000 amps	900v	1200v
Sub or Branch Panel	100,000 amps	900v	1200v

5. Construction: SPD's with a surge current rating of greater than 155,000 amps per mode shall be field serviceable modular devices. SPD's with a surge current rating of less than 155,000 amps may be non-modular.

1.6 DOCUMENTATION

- A. Equipment Manual. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the system.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- 1 Square D
- 2 Cutler-Hammer
- 3 Current Technology
- 4 THOR SYSTEMS

2.2 TRANSIENT VOLTAGE SURGE SUPPRESSION COMPONENTS

- A. The device shall include a solid-state suppression system which includes arrays of fused non-linear voltage dependent metal oxide varistors (MOV's) with similar operating characteristics. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate any other components which may degrade performance or reliability of the

2.3 HIGH-FREQUENCY FILTER

- A. The device shall include a UL 1283 high frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise eliminating disturbances which may lead to system upset. The filter shall provide minimum insertion loss of 45 dB at 100 kHz attenuation frequency utilizing the MIL-STD-E220A 50 ohm insertion loss methodology.

2.4 INTERNAL CONNECTIONS

- A. All internal wiring associated with the suppression/filter device and subject to surge currents shall utilize low-impedance copper bus bar and/or #4 AWG copper conductor or larger. All internal connections associated with the suppression/filter device and subject to surge currents shall be made with compression solderless-type lugs

and shall be bolted to the bus bars in order to reduce overall system impedance.

2.5 FIELD CONNECTIONS

- A. The device shall include mechanical lugs for each phase, neutral and ground, or permanently connected conductors as applicable. The lugs shall accommodate up to #4 AWG copper conductor.

2.6 ENCLOSURE

- A. The device shall be provided in a surface mounted NEMA 1 type hinged enclosure, with a NEMA rating that matches or exceeds that of the switchgear, distribution panel, sub or branch panelboard that is being protected. of minimum 14 gauge steel, painted inside and out. Enclosure width shall not be greater than 24 inches.

2.7 MONITORING

- A. The device shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.
- B. Dry Contacts
- C. Audible alarm with silence switch
- D. For Service Entrance or Switchgear SPD's: LED visual status indicators, Audible alarm with silence switch, Dry Contacts plus Surge Event Counter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation, operation and maintenance instructions, and all national and local codes.
- B. The device shall be installed as close as practical to the facility's wiring system in accordance with NEC Article 285, IEEE 1100-2005 section 8.4.2.5, plus applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be from a minimum 40A branch circuit breaker in the switchgear, distribution panel or panelboard with #4 AWG copper conductors not any longer than necessary, avoiding unnecessary bends. Advise the engineer if the installed In no case shall conductors will be longer than 3 feet in length. Verify circuit breaker size with manufacturer.

3.2 TESTING

- A. The system shall be field tested in the presence of the Owner. At the same time operational procedures shall be reviewed with the Owner.
- B. If external test equipment is required, two (2) testers shall be furnished to the owner and two (2) training sessions shall be furnished. The first training session shall be with 90 days of occupancy and the second training session shall be not less eight months, but not more than 12 months after the first training session. Training and

test equipment shall be furnished at no additional cost to the owner.

END OF SECTION

SECTION 16721
FIRE ALARM/LIFE SAFETY SYSTEM

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Refer to the electrical 16000.

1.2 DESCRIPTION

- A. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- B. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.
- C. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.
- D. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.
- E. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994
- F. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It's acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.
- G. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- H. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

1.3 SCOPE:

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.
- B. Basic Performance:
- 1 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be

- encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
- 2 2. Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
- 3 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
- 4 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- 5 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
- 6 6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
- 7 7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.
- 8 8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
- 9 9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
- 10 10. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
- 11 11. Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
- 12 12. Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
- 13 10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.
- 14 11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:
- 1 a. The digital amplifier shall automatically broadcast the stored audio message.
- 2 b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
- 3 c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
- 4 d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.
- 5 e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
- 6 f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.4 GUARANTY:

- A. The fire alarm control panel, voice panels and any head-end equipment shall have a manufacturer's warranty of a minimum of 3 years.

1.5 QUALIFICATIONS:

1. The fire alarm contractor, as a business entity, shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and servicing fire alarm systems for a period of at least (5) years prior to the bid date.
2. The fire alarm contractor shall have an office within 50 miles of the job site staffed with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system start-up, to instruct the project coordinators representatives and local authorities in the proper operation of the system, and to provide service throughout the warranty period.
3. The fire alarm contractor **SHALL NOT HAVE** any grievances or complaints on record regarding workmanship, code compliance, or service response with either the project coordinator, Architect, Engineer, Owner or the State Fire Marshals office. A contractor that has any prior finding(s) of a Fire Alarm license violation or has any litigation in process with the State Fire Marshal is **unacceptable**.
3. The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

1.6 POST CONTRACT MAINTENANCE:

- A. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.
- C. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.7 APPLICABLE STANDARDS AND SPECIFICATIONS:

- A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.
- B. National Fire Protection Association (NFPA) - USA:

No. 12	Extinguishing Systems (low and high)
No. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam / Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 70	National Electric Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 72	National Fire Alarm Code
No. 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 2572	Mass Notification Systems
No. 217	Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No.60950	Safety of Information Technology Equipment

D. Local and State Building Codes.

E. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories, Inc
ULC	Underwriters Laboratories Canada
FM	Factory Mutual
FM	Factory Mutual Gas Detection System
6320	
NYFD	New York Fire Department
CSFM	California State Fire Marshal

The system shall be listed by the national agencies as suitable for extinguishing release applications. The system shall support release of low pressure CO2.

B. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). For OSHPD applications in California the system shall be Pre-Approved for seismic applications. The basis for qualification of seismic approval shall be via shake table testing.

C. The system shall be approved for Marine Applications and carry the following certifications:

15	
16	1. USCG United States Coast Guard
17	2. Lloyd's Register
18	3. ABS American Bureau of Shipping

D. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

1.11 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Style 4 circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
- E. The system shall be capable of the following configurations. Both configurations are permitted on the same network.
 - 1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
 - 2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall support H-series devices and Cerberus PRO series devices
- G. The system shall have an optional digital alarm communication transmitter.
- H. The system shall provide an off-normal warning prior to reset for all active devices.
- I. The system shall be capable of remote monitoring via Cerberus Remote, a proprietary software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.
- J. The system shall be capable of being configured via a PC Tool.
- K. In networked systems, each of 4 control panels shall be configurable to be a global annunciator, capable of viewing all other control panels on the network.
- L. The system shall provide the following functions and operating features:
 - 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
 - 2. Provide Class B initiating device circuits.
 - 3. Provide Style 4 signaling line circuits for the network.
 - 4. Provide two Class B notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
 - 5. NACs shall be synchronized throughout the entire building.
 - 6. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

- M. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.
- N. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- O. Fire alarm signal initiation shall be by one or more of the following devices:
1. Manual pull station
 2. Heat detector
 3. Addressable area smoke detectors
 4. Addressable Multi-criteria, dual optical smoke detectors
 5. Standard Addressable Duct smoke detector
 6. Specialized Duct Smoke detector
 7. Projected beam detector
 8. Automatic sprinkler system water flow switch.
- P. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using an LCD display with multiple detail screens.
1. Fire Alarm Condition:
 - 1) Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
 - 2) Log into the system history archives all activity pertaining to the alarm condition.
 - 3) Sound the ANSI 117-1 signal with synchronized audible notification appliances and synchronized strobes throughout the facility.
 - 4) Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
 - 5) A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - 6) Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
 - 7) Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the

ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.

- 8) System operated duct detectors as per local requirements shall accomplish HVAC shut down.
- 9) Door closure devices shall operate by floor or by local requirements.

2. Supervisory Condition:

- 1) Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
- 2) Activate supervisory audible and dedicated visual signal.
- 3) Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
- 4) Record within system history the initiating device and time of occurrence of the event.

3. Trouble Condition

- 1) Display at the local fire alarm control panel LCD display, the origin of the trouble condition report.
- 2) Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
- 3) Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
- 4) Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
- 5) Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
- 6) Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.

Q. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1.11 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
 1. Supervisory power requirements for all equipment.
 2. Alarm power requirements for all equipment.

3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 4. Voltage drop calculations for wiring runs demonstrating worst-case condition.
 5. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
- C. Submit manufacturer's requirements for testing Signaling Line Circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. 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.
 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - 1) Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - 2) Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.
 4. Installation drawings shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein.
 5. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
- E. 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. Light fixtures.
 2. HVAC registers
 3. Fire protection equipment interfaces
 4. Special suppression system interfaces
- F. Qualification Data: For qualified Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.
- G. Source quality-control reports.
- H. Field quality-control reports.

- I. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- J. 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.
- K. Warranty: Sample of special warranty.

1.11 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
 - 1. FM Global (Factory Mutual (FM)):FM Approval Guide
 - 2. National Fire Protection Association (NFPA)
 - 1) NFPA 70 National Electrical Code
 - 2) NFPA 72 National Fire Alarm Code
 - 3) NFPA 90A Standard For The Installation of Air Conditioning and Ventilating Systems
 - 4) NFPA 101 Life Safety Code
 - 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
 - 1) UL Fire Protection Equipment Directory
 - 2) UL Electrical Construction Materials Directory
 - 3) UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems
 - 4) UL 228 – Door Holding Devices
 - 5) UL 268 - Smoke Detectors for Fire Protective Signaling Systems
 - 6) UL 268A - Smoke Detectors for Duct Application
 - 7) UL 464 - Audible Signal Appliances
 - 8) UL 497A – Secondary Protectors for Communications Circuits
 - 9) UL 521 - Heat Detectors for Fire Protective Signaling Systems
 - 10) UL 864 - Control Units for Fire Protective Signaling Systems

- 11) UL 1283 – Electromagnetic Interference Filters
- 12) UL 1449 - Transient Voltage Surge Suppressors
- 13) UL 1971 - Signaling Devices for the Hearing Impaired
- 14) UL 2075 – Gas and Vapor Detectors and Sensors
- 15) UL 2572 – Mass Notification Systems
4. International Code Council
 - 1) International Building Code
 - 2) International Fire Code.
5. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
6. California State Fire Marshal
7. NY-MEA
8. The manufacturer shall have a minimum of 15 years production experience in the manufacture and design of high sensitivity aspiration-type smoke detection systems.
9. ISO 9002

B. Supplier Qualifications

1. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid.
2. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law.
3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
4. The suppliers shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.

C. Installer Qualifications:

1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.

2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
3. The contractor shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.
4. The contractor shall be qualified by UL for certifying fire alarm systems.
5. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
6. The fire alarm contractor as a business entity shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and serving fire alarm systems for a period of at least (5) years prior to bid date.
7. The fire alarm contractor shall have an office within 50 miles of the job site staffed with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system start-up, to instruct the project coordinators representatives and local authorities in the proper operation of the system and to provide service throughout the warranty period.
8. The fire alarm contractor SHALL NOT HAVE any grievances or complaints on record regarding workmanship code compliance or service response with either the project coordinator Engineer, Owner or the State Fire Marshals office. A contract that any prior findings of a Fire Alarm license violation or has any litigation in process with the State Fire Marshall is UNACCEPTABLE.
9. The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

PART 2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

1. Edwards System Technology – EST3 Base platform
2. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall list all exceptions taken to these specifications, all variances from these specifications and all substitutions of operating capabilities or equipment called for in these specifications and forward said list to Engineer ten (10) days prior to bid. Any such exception, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination with this specification shall rest with the Engineer, who at his discretion may require proof of performance.

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

- A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
- B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:
 1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

2.2 SYSTEM CAPACITY AND GENERAL OPERATION

- A. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.
- B. The control panel shall be capable of expansion via up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either thpany.
- C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.
- D. The FACP shall be able to provide the following software and hardware features:
 1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
 2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
 3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
 4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
 5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
 6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
 7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
 8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
 9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database

and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.

10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.

19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

21. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result of all cooperating detectors chamber readings.

22. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well as display a FIRE CONTROL Type Code and other information specific to the device.

23. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

24. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
26. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.
27. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
28. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
29. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
30. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
31. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
32. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
33. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
34. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

E. Network Communication

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

F. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
4. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
6. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

G. Display

1. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. The system display shall provide a keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

H. Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
3. Each Loop shall be capable of operating as a NFPA Style 4 (Class B) circuit.
4. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

I. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory

functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

2. Function: The Voice Command Center equipment shall perform the following functions:

- a. Operate as a supervised multi-channel emergency voice communication system.
Operate as a two-way emergency telephone system control center.
- b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
- c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
- d. Provide all-call Emergency Paging activities through activation of a single control switch.
- e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
- f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
- g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
- h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
- i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
- j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

J. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL864 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.
7. Addressable Charger Power SupplyThe auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power. . NOTIFIER model # ACPS-610
8. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.
9. The addressable power supply shall provide four individually addressable Notification

Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.

10. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
11. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
12. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means. Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
13. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
14. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
16. The addressable power supply mounts in either the FACP backbox or its own dedicated surface mounted backbox with cover.
17. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
18. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of an end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
20. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
21. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
22. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power () for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
 - a. Earth Fault on DAP A (Digital Audio Port A)
 - b. Earth Fault on DAP B (Digital Audio Port B)
 - c. Audio Amplifier Failure Detected Trouble
 - d. Active Alarm Bus input
 - e. Audio Detected on Aux Input A
 - f. Audio Detected on Aux Input B

- g. Audio Detected on Firefighter's Telephone Riser
 - h. Receiving Audio from digital audio riser
 - i. Short circuit on speaker circuit 1
 - j. Short circuit on speaker circuit 2
 - k. Short circuit on speaker circuit 3
 - l. Short circuit on speaker circuit 4
 - m. Data Transmitted on DAP A
 - n. Data Received on DAP A
 - o. Data Transmitted on DAP B
 - p. Data Received on DAP B
 - q. Board failure
 - r. Active fiber optic media connection on port A (fiber optic media applications)
 - s. Active fiber optic media connection on port B (fiber optic media applications)
 - t. Power supply Earth Fault
 - u. Power supply 5V present
 - v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble
4. The audio amplifier shall provide the following built-in controls:
- a. Amplifier Address Selection Switches
 - b. Signal Silence of communication loss annunciation Reset
 - c. Level adjustment for background music
 - d. Enable/Disable for Earth Fault detection on DAP A
 - e. Enable/Disable for Earth Fault detection on DAP B
 - f. Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

L. Audio Message Generator (Prerecorded Voice)/Speaker Control:

- 1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
- 2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
- 3. A built-in microphone shall be provided to allow paging through speaker circuits.
- 4. System paging from emergency telephone circuits shall be supported.
- 5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:
 - a. Lamp Test
 - b. Trouble
 - c. Off-Line Trouble
 - d. Microphone Trouble

- e. Phone Trouble
- f. Busy/Wait
- g. Page Inhibited
- h. Pre/Post Announcement Tone

M. Controls with associated LED Indicators:

- 1. Speaker Switches/Indicators
 - a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
 - b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.\
- 2. Emergency Two-Way Telephone Control Switches/Indicators
 - a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
 - b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

N. Remote Transmissions:

- 1. Provide local energy or polarity reversal or trip circuits as required.
- 2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
- 3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
- 4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. Field Programming

- 1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
- 2. All field defined programs shall be stored in non-volatile memory.

P. Specific System Operations

- 1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
- 2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

Q. System Point Operations:

- 1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
- 2. System output points shall be capable of being turned on or off from the system keypad or

the video terminal.

3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

- 1 a. Device Status.
- 2 b. Device Type.
- 3 c. Custom Device Label.
- 4 d. Software Zone Label.
- 5 e. Device Zone Assignments.
- 6 f. Analog Detector Sensitivity.
- 7 g. All Program Parameters.

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4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.

5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.3 SYSTEM COMPONENTS:

A. Conventional Aspirating Detection

1. An optional air aspiration detection system shall be available.
2. The aspirating system shall support multiple sensitivity settings.
3. The aspirating system shall operate from 24 VDC.
4. The aspirating system shall provide alarm and trouble relays used to activate a fire alarm control panel.

B. Aspiration System Interface:

1. The system shall be capable of supporting Interface Modules for integrating Vesda Aspiration detectors into SLC loop of the fire alarm control panel. The Interface Module shall support up to 19 detectors detectors, each SLC loop shall support one interface module.

C. High Level Aspiration System Interface:

1. The system shall be capable of supporting a High Level Interface for Vesda Aspirating Detection Systems. The interface shall support up to 100 detectors and allow the fire alarm network to monitor and control events on the aspiration system.

D. Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.
3. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

E. Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.
2. The handset cradle shall have a switch connection such that lifting the handset off of the cradle shall send a signal to the fire command center which shall audibly and visually indicate its on-line (off-hook) condition.
3. The two-way emergency telephone system shall support a maximum of seven (7) handsets on line (off hook) without degradation of the signal.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
4. Communication shall include vital system status such as:
 - 9 a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - 10 b. Independent Addressable Device Status
 - 11 c. AC (Mains) Power Loss
 - 12 d. Low Battery and Earth Fault
 - 13 e. System Off Normal
 - 14 f. 12 and 24 Hour Test Signal
 - 15 g. Abnormal Test Signal (per UL requirements)
 - 16 h. EIA-485 Communications Failure
 - 17 i. Phone Line Failure
 - 18
5. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
6. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.
7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.
8. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

G. Field Wiring Terminal Blocks

1. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

H. Printer

1. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz.
2. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.
3. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

I. Smoke Control Annunciator

1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.
2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.
3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.
4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.4 GATEWAY & WEBSERVER OPTIONS

- A. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.

B. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.

C. BACnet Interface Gateway: The system shall be capable of being interfaced with BACnet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.

D. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.

E. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.

F. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

G. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.
2. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
4. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
5. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
6. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
7. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
8. Using software in the FACP, detectors shall automatically compensate for dust

accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

11. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

14. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status; NOTIFIER model # NBG-12LX. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be NOTIFIER model # FSP-851 and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent VIEW® Laser Photo Smoke Detector: The intelligent laser photo smoke detector shall be a spot type detector, NOTIFIER model # FSL-751, that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

1. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.

2. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.

3. The laser detector shall not require expensive conduit, special fittings or PVC pipe.

4. The intelligent laser photo detector shall support standard, relay, isolator and sounder

detector bases.

5. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.

6. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Ionization Smoke Detector: The intelligent ionization smoke detector shall be NOTIFIER model # FSI-851 and shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

F. Intelligent Multi Criteria Acclimating Detector: The intelligent multi-criteria Acclimate® Plus™ detector shall be an addressable device, NOTIFIER model # FAPT-851, that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

1. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

2. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

G. Intelligent Thermal Detectors: The intelligent thermal detectors shall be NOTIFIER FST- series addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

H. Intelligent Duct Smoke Detector: The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely. The Intelligent Duct Detector housing shall be model # DNR(W) and the remote test capable photoelectric smoke detector shall be NOTIFIER model # FSP-851R.

I. IntelliQuad™ Advanced Multi-Criteria Intelligent Detector

1. Intelligent multi-criteria fire detector shall be a NOTIFIER model number FSC-851. Smoke detector shall be an addressable intelligent multi-criteria smoke detector. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO) sensor, a daylight-filtered infrared sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

2. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.
3. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20% of the drift range is remaining, when 100% of drift range is used, and when there is a chamber fault to show unit requires maintenance.
4. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
5. The detectors shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 99 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.
7. The detectors shall provide two LEDs to provide 360° visibility. The LEDs are placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED, sounder base, and / or relay base (optional accessories). The external remote alarm can be interconnected to other sounder or relay bases for activating all devices in a space via a single alarming unit.
8. Two LEDs on the sensor are controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, can cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.
9. The detectors shall be ceiling-mount and shall be plug-in mounted into a twist-lock base. These detectors shall be constructed of off-white UV resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. Mounting base shall be mounted on junction box which is at least 1.5 inches (3.81 cm) deep. Mounting base shall be available to mount to standard junction boxes. Suitable boxes include:
 - 19 a. 4.0" (10.16 cm) square box with and without plaster ring.
 - 20 b. 4.0" (10.16 cm) octagonal box.
 - 21 c. 3.5" (8.89 cm) octagonal box.
 - 22 d. Single-gang box.
10. Meets Agency Standards
 - 23 a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
 - 24 b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
 - 25 c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling

J. IntelliQuad™ PLUS Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector shall be NOTIFIER model # FCO-851 and shall be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.
2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.
4. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.
6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
8. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.
9. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.
10. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.
11. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

- 26 a. 4.0" (10.16 cm) square box with and without plaster ring.
 - 27 b. 4.0" (10.16 cm) octagonal box.
 - 28 c. 3.5" (8.89 cm) octagonal box.
 - 29 d. Single-gang box.
 - 30 e. Double-gang box
12. Meets Agency Standards
- 31 a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
 - 32 b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
 - 33 c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
 - 34 d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

K. Intelligent Addressable Aspiration Detector: The intelligent aspiration detector shall be NOTIFIER model # FSA-8000 an addressable aspiration detector that communicates directly with the fire alarm control panel via the SLC communication protocol, no modules or high level interfaces shall be required. The fire alarm control panel shall support up to thirty one intelligent aspiration detectors per SLC loop. The aspiration detector shall have dual source (blue LED and infra-red laser) optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates. The FACP shall be capable of monitoring and annunciating up to five smoke event thresholds and eleven trouble conditions. Each event threshold shall be capable of being assigned a discrete type ID at the FACP.

L. Intelligent Addressable Reflected Beam Detector

- 1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch; NOTIFIER model # FSB-200. Model # FSB-200S shall be equipped with an integral sensitivity test feature.

M. Addressable Dry Contact Monitor Module

- 1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. The addressable monitor module shall be NOTIFIER model # FMM-1 (Class A or B) or FMM-101 (Class B)
- 2. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- 3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.
- 4. For multiple dry contact monitoring a module shall be available that provides 10 Style B or 5 Style D input circuits; NOTIFIER model # XP10-M.

N. Two Wire Detector Monitor Module

- 1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device); NOTIFIER model # FZM-1.
- 2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
- 3. For multiple 2-wire smoke detector circuit monitoring a module shall be available that

provides 6 Style B/Class A or 3 Style D/Class B input circuits; NOTIFIER model # XP6-MA.

O. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances; NOTIFIER model # FCM-1
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y;
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.
4. For multiple circuit control a module shall be available that provides 6 Style Y (Class B) or 3 Style Z (Class A) control circuits; NOTIFIER model # XP6-C.

P. Addressable Releasing Control Module

1. An addressable FlashScan releasing module shall be available to supervise and control compatible releasing agent solenoids; NOTIFIER model # FCM-1-REL.
2. The module shall operate on a redundant protocol for added protection.
3. The module shall be configurable for Style Z or Style Y (Class A/B) and support one 24 volt or two 12 volt solenoids. Add FMM-4-20

Q. Addressable 4-20 mA module shall be available to monitor industry-standard, linear-scale, 4-20 mA protocol sensors. The module converts the sensor output to communication protocol that can be interpreted by the FACP for monitoring and display; NOTIFIER model # FMM-4-20.

1. The module shall support programming of up to five programmable event thresholds.
2. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

R. Addressable Relay Module:

1. Addressable Relay Modules shall be available for HVAC control and other network building functions; NOTIFIER model # FRM-1.
2. The module shall provide two Form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires;
- 20 4. For multiple relay control a module shall be available that provides 6 programmable Form-C relays; NOTIFIER model # XP6-R.

S. Addressable Two-In / Two-Out Monitor/Relay Module:

1. An addressable Two-In / Two-Out module shall be available; NOTIFIER model # FDRM-1.
2. The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

T. Isolator Module: Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building; NOTIFIER model # ISO-X.

1. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall

automatically reconnect the isolated section.

2. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
3. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

U. Serially Connected Annunciator Requirements

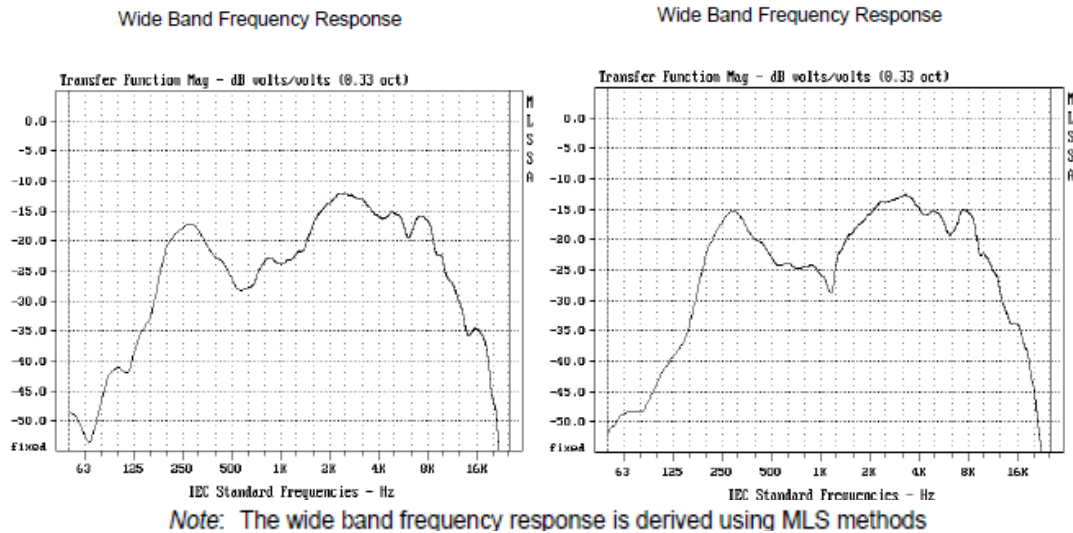
1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. The repeater shall be UL864 approved.
3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.
5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

V. SpectrAlert Advance Speakers

1. The Speaker appliance shall be System Sensor SpectrAlert Advance model _____ Speaker. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible.

Ceiling Speaker

Wall Speaker

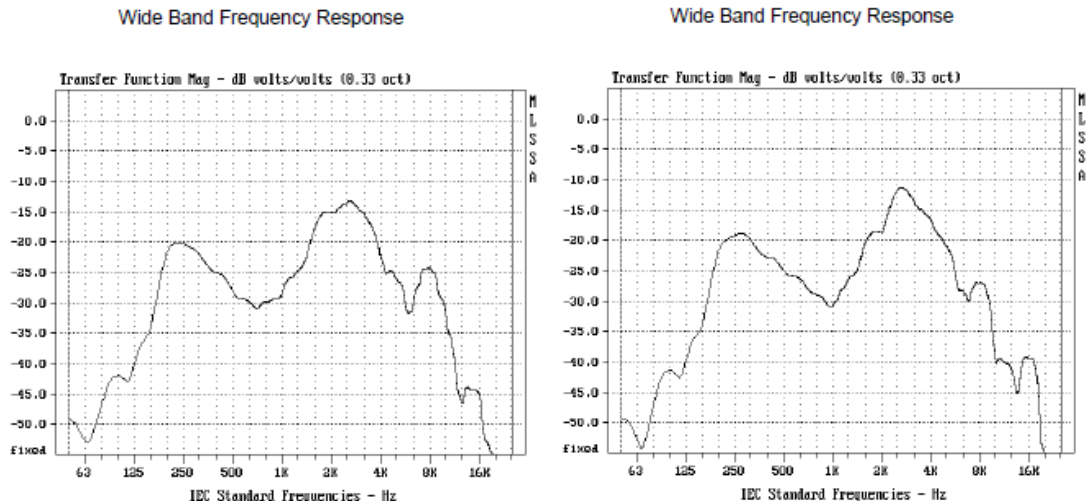


W. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance SPS and SPV series Speaker Strobe. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit™ Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.
5. All notification appliances shall be backward compatible.

Ceiling Speaker Strobe

Wall Speaker Strobe



Note: The wide band frequency response is derived using MLS methods

6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and be fully synchronized.

X. FIRE ALARM CABLE

1 The fire alarm cable shall plenum rated and be UL listed and suitable for use as power limited fire protective signaling circuit cable in accordance with National Electric Code Article 760 (Fire Alarm Systems) and Article 725 (Class 1, Class 2 and Class 3 - Remote Control, Signaling and Power-Limited Circuits).

A. Cable Construction

- 1 Conductors shall be solid, soft annealed, uncoated copper.
- 2 Insulation shall be 300 volt, 105°C polyvinylchloride.
- 3 Two conductor, non-shielded cables shall be parallel; shielded and three or more conductors shall be cabled round.
- 4 Shielding shall be mylar backed aluminum foil, helically wrapped to provide 100% coverage. A suitable copper drain wire shall be provided with shielded cables.
- 5 Jacket shall be red, 105°C polyvinylchloride, rated 300 volt.
- 6 Cable shall be plenum rated when installed in air handling plenums.

B. In general, non-shielded cable is acceptable for use throughout except on voice circuits. All voice circuits shall utilize shielded, twisted pair cable.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on

the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all waterflow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

SECTION 16726
INTRUSION / ACCESS INTEGRATED SYSTEM

1.0 GENERAL

1.1 MANUFACTURER

- A. The manufacturer shall have at least thirty-five (35) years of experience in the role of fire and security control manufacturing, and a proven track record of forward and backward compatibility for a minimum of twenty (25) years for its product's auxiliary devices, including system keypads, annunciation devices, zone expansion modules, and addressable detection devices.
- B. The manufacturer must also manufacture receiving equipment that is compatible with standard dial-up telephone lines, network, and cellular network monitoring equipment that is compatible with a LAN, WAN, and the Internet. The receiving equipment shall be capable of receiving all status and alarm messages generated by the system. The receiving equipment shall be capable of updating the panel operating program and the system date and time.
- C. Commercial Intrusion detection/Access control /Household Fire Alarm Control Panel equipment manufacturer shall be:

Digital Monitoring Products, Incorporated (DMP) #550N

2500 N. Partnership Boulevard, Springfield, MO 65803

Telephone (417) 831-9362 FAX (417) 831-1325

1.2 INSTALLER

- A. The installing company shall show proof of having regular experience with design, installation, service, and maintenance of manufactured systems for a minimum of the last twelve (12) calendar months from the project start date. Each system installer and service person must provide manufacturer certification of technical training for installation, service, and system maintenance. Certification shall be proven with an official document issued by the manufacturer.
- B. The installing company shall provide a minimum of 8 (eight) verifiable references from its clients where the manufacturer's system has been installed within the last twelve (12) calendar months from the project start date.
- C. The installing company shall furnish and install a complete electrically supervised DMP panel, as detailed in this specification. The system shall be inclusive of all necessary function, monitoring, and control capability as detailed herein and on accompanying shop drawings.
- E. The installing company shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work. Materials shall be installed in strict compliance with local building codes. All work shall be performed in accordance with Digital Monitoring Products, Inc. instructions. Components must be installed and serviced by a dealer in good standing that is factory-trained by Digital Monitoring Products.

1.3 CENTRAL REPORTING STATION

- A. The central reporting station contractor must possess an Underwriter's Laboratory (UL) listing as a "Mercantile Police Station" or "Mercantile Burglar Alarm Systems" company. A copy of the listing shall be attached as a part of this bid package.
- B. The actual alarm signal receipt and processing is a significant portion of the scope of work. Third party and/or contract stations are permitted. UL must list the monitoring station for Protective Signaling Services or Central Reporting Station Signaling Services. A copy of the station UL listing shall be attached as part of this bid package.
- C. The monitoring station must provide openings/closing activity reports, activity day and time, authorized individual, office name and account number and the system type being monitored. These reports are to be mailed to the user's office at the end of each month. The Office Manager or Contract Administrator may request an additional report if an incident occurs.
- D. The contractor must have a valid Alarm Operator License. A copy of licenses shall be attached as part of this bid package.

E. The contractor may be required to monitor a portion of the alarm systems by way of the end user data network.

F. The contractor shall become familiar with all work details, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work.

G. The end user shall not incur any central station setup charges by the contractor to receive alarm signals by way of the end user data network.

2.0 SCOPE

2.1 REQUIREMENTS

A. Furnish and install a complete Intrusion Detection/Access Control system with the performance criteria detailed in this specification. The system shall be inclusive of all necessary functions, monitoring, and control capability as detailed herein and on accompanying Shop drawings.

- On-site or remote video monitoring
- Heating, air conditioning, and lighting management
- Temperature threshold detection and monitoring
- Humidity threshold detection and monitoring
- Pressure threshold detection and monitoring
- Power loss detection and monitoring, generator switching
- Leak detection and monitoring
- Carbon Monoxide detection and monitoring
- Tank level threshold detection and monitoring

B. This specification document provides the requirements for the installation, programming, and configuration of a complete DMP panel. This system shall include, but not be limited to:

- Control panel
- System cabinet
- Power supply
- Digital Signaling Line Circuits (SLC)
- Notification Appliance Circuits (NAC)
- Annunciator/keypad bus
- Batteries
- Wiring
- Conduit
- Associated peripheral devices

- Other relevant components and accessories required to furnish and install a complete and operational addressable reporting Life Safety System.

2.2 STANDARDS

The system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings	U.S. Government Standards/Listings
UL 1023 Household Burglar Alarm System Units	Meets ICD 705 Chapter 7 Intrusion Detection Systems (IDS)
UL 1076 Proprietary Burglar	Meets DoD/NIST SCIF Standards
UL 1610 Central Station Burglar Alarm Units	Related Standards
UL 1635 Digital Burglar Alarm Communicator System Units	NFPA 70 National Electric Code (NEC)
Fire Listings	NFPA 72 Local Protective Signaling
UL 864 Control Units for Fire Protective Signaling Systems	NFPA 72 Remote Station Protective Signaling
UL 985 Household Fire Warning	NFPA 72 Proprietary Protective Signaling
California State Fire Marshal	NFPA 72 Household Fire Warning
New York City FDNY COA #6167	Canadian Burglary Listings
Access Control Listings	ULC C1023 Household Burglar
UL 294 Access Control System Units	ULC/ORD-C1076 Proprietary Burglar
NIST	ULC S304 Central Station Burglar
AES Algorithm Certificate #2350 128	Canadian Fire Listings
AES Algorithm Certificate #2595 256	ULC S545 Household Fire
	ULC S559 Fire Signal Receiving Centres and Systems

2.3 Americans with Disabilities

All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

3.0 SUBMITTALS

3.1 GENERAL REQUIREMENTS

The contractor shall submit three (3) complete sets of documentation within thirty (30) calendar days after contract award date. Indicated in the document shall be the manufacturers' names, catalog number, type, size, style, rating, and catalog data sheets for all items proposed to meet these specifications.

3.2 SHOP DRAWINGS

Shop drawings shall be submitted in accordance with Section 3.0 Submittals and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.

3.3 AS-BUILT DRAWINGS

The contractor shall provide a complete set of as-built drawings for the entire system upon installation completion. These drawings shall include, but not be limited to, the exact locations of all equipment, connections between all equipment, and wiring for all equipment as the system is installed.

3.4 SPARE PARTS DATA

After shop drawings are approved, and not later than thirty (30) calendar days prior to the date of beneficial occupancy, a list of spare parts data for each item of specified materials and equipment shall be submitted. The data shall include a complete list of parts and supplies with current unit prices and source of supply. Spare parts shall consist of, but not be limited to, five (5) percent of all initiating and notification appliances with a minimum of one (1) each. All spare parts shall be on site prior to commencement of acceptance testing. Depleted spare parts shall be replaced prior to beneficial occupancy.

3.5 OPERATING DOCUMENTS

The contractor shall furnish to the architect operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

3.6 MAINTENANCE DOCUMENTS

The contractor shall furnish maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides at least 30 calendar days prior to acceptance test.

3.7 PERFORMANCE TEST REPORTS

Upon the installed system completion and testing, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with specified performance criteria.

3.8 WARRANTY

A copy of the manufacturer's warranty for all equipment and materials shall be provided. Warranty shall be for all equipment, materials, installation, and workmanship for a minimum of three (3) years, unless otherwise specified.

4.0 GENERAL COMPONENT REQUIREMENTS

4.1. COMPONENT ENCLOSURE

Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tamperers listed for use with the XR150/XR350/XR550 with Network and Encryption shall be used.

4.2 ELECTRONIC COMPONENTS

- A. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
- B. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and Loop Expansion LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the Loop Expansion LX-Bus(es) and Keypad bus are shut down.

4.3 CONTROL UNIT

- A. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
- B. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
- C. Control unit must be “Flash ROM” updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
- D. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router for SCIF (Sensitive Compartmented Information Facility) application that is certified by NIST (National Institute of Standards and Technology) for 128-bit or 256-bit AES (Advanced Encryption Standard) Encryption communications.
- E. The optional built-in Encrypted Alarm Router shall be capable of compliance with ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.

4.4 REMOTE ANNUNCIATORS

- A. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.
- B. The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

4.5 CONTROL DESIGNATIONS

Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function; controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

4.6 TEST FUNCTION

- A. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.
- B. The system shall include a provision for an automatic, hourly, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.
- C. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.

4.7 POWER SUPPLIES

A. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.

B. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.

C. Approved power supplies shall meet or exceed the following power supply model specifications:

- UL Listed DMP 505-12: 12VDC 5 Amp with transformer and enclosure.

4.8 SOFTWARE

A. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:

- Direct cable connection interface card
- Receiver phone line connection
- Standard phone line connection
- Ethernet network connection
- Network connection across the Internet
- Cellular network connection using the 263C or 263H Cellular Communicators

B. The system shall interface with computer software capable of locking down all controlled doors.

C. The system shall interface with computer software capable of monitoring and logging all events.

D. The system shall interface with computer software capable of exporting reports in the following file formats:

Excel spreadsheet (*.xls)	Text (*.txt)
Rich Text (*.rtf)	Comma-separated (*.csv)
Windows Metafile (*.wmf)	HTML document (*.htm)
QuickReport (*.qrp)	

E. The system shall interface with computer software capable of printing custom, filtered reports including:

All Events	Door Access Granted
Zone Action	Door Access Denied
Arming/Disarming	Opening/Closing Schedule Changes

Area Late to Close	System Monitors
User Code Changes	System Events

4.9 GRAPHIC USER INTERFACE (GUI)

Entré – Access and Security Management Software

System Features:

A. The software shall be available in three package sizes.

Entré Lite™: Shall have 16 doors included, and a maximum of four XR150/XR350/XR550 Series panels, personnel management, full reports, and event management.

Entré Business™: Shall have the same features as Entré Lite with the option of expansion to 96 doors maximum and up to 24 XR150/XR350/XR550 Series panels.

Entré Enterprise™: Shall have the same features as Entré Business with 96 doors included with the ability to expand to an unlimited number of doors, users and XR150/XR350/XR550 Series panels.

B. Shall have simple user management, with the ability to import users from existing databases.

C. Shall be able to assign user access by group, facility or other parameters.

D. Shall have drop down lists for devices, user data and other information to facilitate fast and accurate searches.

E. Shall be able to view system status in one of a variety of views for simplified alarm monitoring management.

F. Shall have the capability to customize reports for added flexibility.

User Management:

A. It shall have the ability to import into Entré from existing systems via standard comma-separated value (CSV) format files. It shall easily add new users, capture and edit their photo for badging or visual verification from within the application.

B. User fields shall be fully customizable. Assign specific rights or events by user or by group. The software shall be able to create effective/expiration time for users, limiting access to only certain times of the day, and only certain days, or for only a defined period of time.

AES Encryption:

A. Entré Enterprise shall support the XR550N Series with Encryption panel AES (Advanced Encryption Standard) strong data security for sensitive personnel and facility data.

Highly Customizable:

A. The software shall be extensively customizable to create a system that matches the end user's application's needs.

B. Shall define what events are considered "alarms," and what response is required from the system operator.

C. Shall be able to tailor user data with up to 20 available user-defined fields.

Hierarchical Views:

A. The software shall have the ability to select from four different system views, with the ability to have multiple views open simultaneously. Select the graphical Map view, tabular Event view, or hierarchical Tree view.

B. The software shall be able to click on a device or alert to access additional information and process the event. In text-based views, software shall have simple drill downs to allow fast navigation to the desired item.

Powerful Search:

The software shall employ industry standard SQL database for quick and easy search to identify any desired device or user which is compatible with nearly any database.

Single-System Control:

The software shall employ a network solution to manage installations and users from any location. A single, unified database means there's one badge, one face or one fingerprint, worldwide.

Entré – Access & Security Management Software

Optional System Modules:

- ENTRE-4DR Additional 4-Doors
- ENTRE-16DR Additional 16-Doors
- ENTRE-32DR Additional 32-Doors
- ENTRE-64DR Additional 64-Doors
- ENTRE-STD Standard Client
- ENTRE-WEB Web Client
- ENTRE-MAPS Alarm Graphics
- ENTRE-AUTO Automation Module
- ENTRE-DVR DVR Module
- ENTRE-PART Database Partitioning
- ENTRE-LANG Multiple Language module
- ENTRE-LDAP Lightweight Directory Access Protocol
- ENTRE-IMAGE Personnel Image Capture
- ENTRE-BADGE Badge Designer
- ENTRE-SIGN Signature Capture

Optional System Modules Features:

- A. Shall be able to Point-and-click control of alarms and devices.
- B. Shall have a modular design to enable customization, with optional modules for added features.
- C. Shall be available in French, Spanish, or English, with dual- language operation mode.
- D. Shall have full reporting, including at-a-glance dashboard graphics and charts or traditional tabular displays, with the ability to produce reports in a variety of file types.

- E. Shall have DVR integration.
- F. Shall have image management of users and event photos.
- G. Shall have a custom badge builder and video badging.

Door Modules:

The software shall allow for the addition of additional doors to support Entré Business or Enterprise systems.

Alarm Graphics:

- A. The software shall allow for the addition of additional doors to support Entré Business or Enterprise systems.
- B. Shall have the ability to give graphical representation of events and alarms at-a-glance and give feedback of system status.
- C. Shall have the capability to upload an unlimited number of graphical images of protected facilities in a variety of file formats.
- D. System maps are linked from level to level, allowing drill down from a macro view to a specific room or area.
- E. View alarm status at every level of zoom.
- F. User-defined layers representing different alarm types allow you to customize the graphical interface to meet application needs.
- G. Once loaded, it shall have the ability to plot alarm devices on the graphics using drag-and-drop selections from a hierarchical list of hardware. Identify the areas on your site maps, defining them by Classification, Entrances, Zones, and Partitions.
- H. It shall have total picture-based monitoring and control of the system. It shall from facility-wide views be able to click to zoom in on any area of the facility and view the real-time status of any device.
- I. The software shall be able to click on the alarm display icon to acknowledge an alarm or to request additional information

Automation Module:

- A. The software shall be able to give advanced users the power to create automated system actions.
- B. The software shall be able to define automatic responses to any system alarm or events. These include generating a report, generating an alert email, or sending commands to selected devices.
- C. Shall be able to create scheduled system actions to run once at a specified time and date, or scheduled events that repeat at user defined time and date intervals.
- D. System automation enables configuration of unattended activities, freeing system managers from many routine responsibilities.

DVR:

- A. The software shall be able to quickly connect to a DVR to review video based on a received alarm from a control panel.
- B. Connect to DVR from a graphical map of the area to review activity.

- Verint

NetDVR I, firmware 6.47.x or higher

NetDVR II, firmware 8.7.x or higher

EdgeVR, all firmware versions

- 3VR

E-Series

P-Series

S-Series

ServerClass

- March Networks™

3204 Digital Video Recorder (3000 Series)

4000 C NVR (4000 C Series)

- Dedicated Micros

All NetVU compatible series 2 and 3 DVRs

Database Partitioning:

A. The software shall allow system information to be contained in a single unified database allowing system managers to limit user access to only certain areas of the database to partition the information.

B. The software shall allow organization of data into separate collections by physical area, hardware types, events, or other parameters.

Multi-Language:

A. The software shall support multiple languages enabling multiple operators to select a language during their login process. The software shall allow text shown both in English and a second selected language.

B. Available languages shall include:

- English
- French
- Spanish

LDAP (Lightweight Directory Access Protocol):

A. The software shall provide LDAP single sign-on for users, enabling them to use one password to access multiple system services.

B. System user information can be imported directly from an existing LDAP Tree.

Badge Image Capture:

The software shall allow the transfer of pictures of users from a digital camera directly onto a badge. Select a TWAIN source to capture the image to allow up to date images on employee badges.

Badge Designer:

A. The software shall have the ability to create one or more badge designs, customizing badges by facility, user level, or other parameters.

- B. When badging employees or visitors, select the desired badge template from library. The template automatically populates with the appropriate data, ready for printing.

Signature Capture:

Shall use a signature capture device to provide the ability to capture employee or visitor signatures and store the images.

Reporting Dashboard:

- A. The software shall have interactive graphics for instant feedback on system activity.
- B. The software shall be able to choose a number of charts for functions such as Access Granted /Denied at a particular access point or an entire facility to get a snapshot of activities within any defined time period.
- C. Shall have ability to filter through user, activity, or event data to narrow results and show precisely the information needed.
- D. Shall have the ability to view reports from within the application, or saved and exported to PDF, HTML, XLS, CSV, or XML format for distribution.
- E. Shall automate custom reports to generate and distribute each day at desired times.

4.10 CONTROL PANEL CAPABILITY

A. The basic control panel shall provide:

- Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
- Temporary user codes that can be entered with a finite date and specific time to expire.
- Sixteen (16) independent door/keypad addresses, each with four zones on XR550 and XR350, with eight (8) on the XR150.
- A total door access granted event buffer of at least 10,000 events.
- Anti-passback access control selectable by area and user.
- A total of at least 99 programmable Schedules for output relay schedules, area schedules, door schedules, holiday schedules, and user profiles. The same schedule may be assigned to more than one area, door, or output, making them reusable. There shall be at least two schedules per user profile with up to four profiles per user. Up to 8 Schedules per user, per door, per area, and per output.
- Eight Areas (8) individual reporting areas XR150, Sixteen (16) individual reporting areas XR350, and Thirty-two (32) individual reporting areas XR550.
- Built-in bell and telephone line supervision.

B. The networked control panel shall provide the entire above plus:

- All of the above features plus.
- Require two-man access code or credentials. Require two user code entries to disarm and/or allow door access to this area.
- Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.
- Early Morning Ambush. Must disarm a second time within a programmed period of time or an early morning ambush silent alarm is sent.
- Bank Safe & Vault features. Schedules set for this area and the time of day cannot be changed while the area is armed.

C. The XR550 encrypted control panel shall provide the entire above plus:

- All of the basic and network features listed plus.
- Built-in Encrypted Alarm Router.
- Certified operation that meets NIST (National Institute of Standards and Technology) standards for 128-bit and 256-bit AES (Advanced Encryption Standard) Encryption.
- Certification that encrypted panel is capable of meeting ICD 705 Chapter 7 Intrusion Detection Systems (IDS) Standard.
- Certification that encrypted panel is capable of meeting UL 2050 standards.
- Card plus Pin for High security card access is provided by the Card Plus Pin feature that requires both a card read and a PIN (4-6 digit user ID) entry for arming/disarming and access by area. This Card Plus Pin operation complies with the ICD 705 requirement for dual id authentication and operates with a DMP Prox Keypad and a HID ProxPro reader with the keypad connected to a DMP Wiegand Interface module.
- Panic Test allows the panic zone test verification and failure results to be sent to the central station receiver.
- Passphrase of 8-16 characters to validate encryption between the XR550 with Encryption and the Central Station Receiver.

5.0 FUNCTIONAL DESCRIPTIONS

5.1 SYSTEM DESCRIPTION

- A. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
- B. To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
- C. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.
- D. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, Text messaging, or Smart Phone Application using integrated or auxiliary devices provided by the system manufacturer.
- E. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/or wireless zone expansion equipment for at least 500 wireless zones and/or a maximum of 574 hardwired zones.
- F. The system shall be capable of offering up to five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.
- G. The system shall provide a seamless capability to provide up to 506 addressable relays, which can be located at any connection location upon a zone expansion bus.
- H. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
- I. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.

- J. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet, cellular communications paths.
- K. The control unit shall be completely programmable remotely using remote annunciators, and/or using upload/download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.
- L. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

5.2 INPUT/OUTPUT CAPACITY

- A. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 506 output relays.
- B. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 Amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 506 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).
- C. The panel shall also provide 99 programmable output profiles for schedules, and include an integral bell alarm circuit providing at least 1.5 Amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.
- D. The system shall be capable of supporting and controlling up to 232 Z-Wave devices and up to 20 Z-Wave Favorites for group control.

5.3 USER/AUTHORIZATION LEVEL CAPACITY

The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

5.4 KEYPADS

- A. The system shall support a maximum of sixteen (16) keypads on XR550N/XR350 Series or eight (8) keypads on XR150 Series with alphanumeric display. The keypad shall be THINLINE 7070 LCD. Each keypad shall be capable of arming and disarming any system area based on a pass code or Proximity key authorization. The keypad alphanumeric display shall provide complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.
- B. Communication between the control panel and all keypads and zone expanders shall be multiplexed over a non-shielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.
- C. If at any time a keypad does not detect polling; the alphanumeric display shall indicate "SYSTEM TROUBLE". If at any time two devices are programmed for the same address, the alphanumeric keypad shall display "4 WIRE BUS TROUBLE". If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate "NON POLLED ADDR". The system shall display all system troubles at selected keypads with distinct alphanumeric messages.
- D. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.
- E. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen in all software reports, keypad displays, and central station reports.
- F. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.

G. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.

5.5 ZONE CONFIGURATION

A. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders on the XR550. It shall also have the capacity of a maximum of 125 supervised relay output expanders. The XR350 shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders. It shall also have the capacity of a maximum of 75 supervised relay output expanders. The XR150 shall have the capacity for a maximum of eight (8) keypads and a maximum of 25 four (4) zone expanders. It shall also have the capacity of a maximum of 25 supervised relay output expanders. All Class B zones shall be 2-wire, 22 AWG minimum, supervised by an end-of-line (EOL) device and shall be able to detect open and short conditions in excess of 500ms duration.

B. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.

C. The digital SLCs and the annunciator/keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus repeater modules are installed.

D. Each zone shall function in any of the following configurations:

Night	Supervisory	Auxiliary 1	Cross-Zone
Day	Emergency	Auxiliary 2	Priority
Exit	Panic	Fire Verification	Arming
Fire			

5.6 COMMUNICATION

A. The system shall be capable of signaling to as many as 8 remote monitoring station receivers. Seven (7) of the eight (8) paths shall be capable of being assigned as either a “primary” or “backup” path. In such a manner the system shall have multiple primary paths to multiple remote monitoring stations as well as multiple backup paths to multiple monitoring stations.

B. The system shall employ Adaptive Technology that allows a Backup communication path programmed for Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable. This creates a seamless transition for communication.

C. The system shall be capable of dialing up to (2) remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another event occur that requires a report to be transmitted, the dialing sequence shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.

D. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least one other standard industry format.

E. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

5.7 NETWORK COMMUNICATION

- A. The control panel shall be capable of asynchronous network communication with a retry time between 2 and 240 minutes and a fail time of 2 and 240 minutes. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.
- B. The control panel shall employ adaptive communication technology. Adaptive Technology allows a Backup communication path programmed to use Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable, creating a seamless transition for communication of messages. Select Adapt when programming the Checkin option. This allows a system to be fully supervised even if a path fails, while also keeping wireless charges low when the network is good.
- C. Network communication between the control panel and the receiver shall be in a proprietary communication format.
- D. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
- E. Underwriters Laboratories (UL) shall list network communication by the control panel for Standard or Encrypted Line Security.
- F. The control panel shall be capable of two-way network communication using standard Ethernet 10/100 BaseT in a LAN, WAN, or Internet configuration.
- G. The control panel shall be capable of communication by means of a 128-bit or 256-bit AES (Advanced Encryption Standard) Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with an SCS-104 line card or SCS-VR (SCS-VR currently supports 128-bit encryption only).
- H. The control panel shall be capable of meeting ICD 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.
- I. The control panel shall be capable of sending text messaging to up to three Cellular Phone Numbers using cellular communications.
- J. The control panel shall be capable of sending the following SMS messages:

Zone Alarms by Zone Name	AC Power Trouble and Restoral
Zone Troubles by Zone Name	System Low Battery
Zone Bypass by User	Ambush
Arming (Closings) by User	Abort, Cancel and Alarm Verified by User
Disarming (Openings) by User	Check-in by user
Late to Close	

5.8 CELLULAR COMMUNICATIONS

- A. The control panel shall have the capability to communicate with a plug-in cellular HSPA+ communicator model number 263H or CDMA communicator model number 263C that shall plug into the control panel J24 connector which shall supply full data communication and power to the 263H or 263C cellular communicator. The cellular communicator shall be capable of communicating full panel alarm and auxiliary messages to the DMP SCS-1R Central Station or SCS-VR Receiver as well as SMS text messaging to a PC, PDA, or Cellular telephone.
- B. The control panel shall be capable of sending the following SMS messages

Zone Alarms by Zone Name	AC Power Trouble and Restoral
Zone Troubles by Zone Name	System Low Battery
Zone Bypass by User	Ambush
Arming (Closings) by User	Abort, Cancel and Alarm Verified by User
Disarming (Openings) by User	Check-in by user
Late to Close	

5.9 TCP/IP NETWORK TRAPPING

- A. The control panel shall be capable of having communication set to Network operation. When a trap is set in Remote Link, the software shall be capable of sending a panel trap message with the panel account number to the SCS-104 installed in an SCS-1R receiver.
- B. The receiver SCS-104 shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver SCS-104 shall then send a message to the panel to contact Remote Link at the IP address contained in the original trap message.
- C. The trap message shall be stored in the receiver SCS-104 for up to four hours. If the trap message is not sent to the panel within the four-hour window, the panel trap message shall be discarded and a new trap message must be sent from Remote Link.
- D. The user shall be able to view the trap status in the receiver SCS-104 in Remote Link using the Trap Query function.

6.0 INTEGRATED INTRUSION ALARM AND ACCESS CONTROL OPERATION

6.1 ACCESS AUTHORITY LEVELS

The system shall be capable of programming access credentials authority levels to check whether the user has access to a specific area and also has the authority to disarm or arm the area. If the user access credential has access and disarm/arm authority the system shall provide the user the option to disarm the area simultaneously upon opening the door, or to open the door and begin an entry delay timer. With the timer option the user then disarms the area using an intrusion control keypad inside the area. If the user only has access authority to the area and the area is in an armed condition, the user is denied access to the area.

6.2 DOOR OPEN SCHEDULE OVERRIDE

The system shall be capable of programming certain area doors to be scheduled to unlock and lock at specific times of the day or night. The lock/unlock function shall be capable of an override option depending upon the area armed/disarmed status. If the area remains in an armed status at the scheduled unlock time the armed status overrides the unlock schedule ensuring the doors remain locked and armed in situations where the business might open late, close early, is affected by inclement weather, or another emergency.

6.3 COMMON AREA

The system shall be capable of programming a common area to be armed when the last area in the system is armed and disarmed when the first area in the system is disarmed. To ensure the common area works properly it shall not have any user codes assigned to the common area. The system shall also be capable of programming multiple common areas.

6.4 AREA ACCESS CONTROL

A. The system shall be capable of integrating area access control capability where specified into the same control panel with the ability to have up to 10,000 user credentials. User access is limited to custom profiles and/or schedules. Anti-passback shall be available. The networked version shall support a Two-Man Rule feature. The system shall support up to sixteen (16) access doors, connected to the system using a manufacturer-approved interface module.

B. Area door access products shall meet or exceed features offered by the following products:

- Wiegand Interface – DMP Model 734,
- Reader – DMP Model PP-MP-5365
- Cards or credentials – DMP Model 1326, DMP Model 1306P, DMP Model 1346, DMP Model 1386

6.5 ACCESS CONTROL EQUIPMENT

Access Control equipment shall communicate to the system by way of the control panel keypad bus. The equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 11.5 of this document.

6.6 EARLY MORNING AMBUSH (XR550 ONLY)

A. The system shall be capable of programming an area to require two user codes be entered within a programmed number of minutes to prevent an ambush message from being sent to the Central Station Receiver. If both user codes are not entered within the time an ambush message is sent to the central station receiver.

B. Both user codes shall have the authority to disarm the specific area and must be entered at the same keypad or reader. The keypad shall not display any indication that the ambush timer is running.

C. The system shall be capable of programming an output to provide an external indicator that an ambush situation is taking place.

6.7 TWO-MAN RULE (XR550N ONLY)

The system shall be capable of programming an area to require two separate user codes be entered in order to disarm and/or allow access to a specific area. Both required codes shall have at least the same or greater authority level. Both required codes shall be entered within 30 seconds or an alarm shall activate.

6.8 PANIC BUTTON SUMMARY TEST

A. The system shall have the ability to test panic buttons without sending a panic alarm to the Central Station Receiver.

B. The system shall also have the ability to send panic zone test verification and failure results to the Central Station Receiver.

C. During the test, each time a panic zone trips, the display number shall increment and the keypad buzzer sound for two seconds.

D. The number of panic zones tripped shall constantly display until the test ends or no panic zone activity has occurred for 20 minutes.

E. When the Panic Zone Test ends and a zone failed (did not trip) during the test, the keypad shall be able to display the zone name and number and have the buzzer sounds for one second. Additional zone failed zones shall display when a button is pressed.

6.9 ONE-MAN WALK TEST

A special code is also available for installers to test the system. The One-Man Walk Test feature allows a single technician to check the panel response to burglary, fire, panic, and supervisory zones.

6.10 MULTI-LINGUAL DISPLAY OPTION

The system shall be programmed to display the User Menu and Status Display text in multiple languages.

6.11 USER INACTIVITY AUDIT

System shall allow user code inactivity to notify the central station after a programmable period of days of no activity. The system shall be programmable from 0-365 days.

6.12 LOCK DOWN

The system shall for emergency situations, a lock down command can be issued from the keypad menu or via remote command and locks all doors designated as public.

6.13 COMMUNICATION FUNCTION DIAGNOSTICS

The system shall have enhanced diagnostic menu that enables technicians to check network and cellular communication status and cell signal strength from the keypad.

6.14 GUEST OPERATION

The system shall be capable of in the Home/Sleep/Away with Guest House operation, create up to three separate systems (main and two guests). Keypads in each system can selectively arm the perimeter, interior, or bedrooms for only their protected areas. Main system users can add authorized users to all protected areas, but guests can add users only for their protected system.

7.0 FALSE ALARM REDUCTION FEATURES

The system shall be capable of providing false alarm reduction features, functions, capabilities, or processes that either require alarms be verified or potential alarms be corrected before a system or zone can be placed into an armed state.

7.1 EXIT ERROR ALERT AND REPORTING

The panel shall be able to provide an automatic function to prevent a false alarm from occurring if an exit door does not properly close after the system is armed.

7.2 ENTRY AND EXIT DELAY ANNUNCIATION

A. When arming, the system shall provide clear annunciation indicators to the user about the need to exit the premises prior to the exit delay time expiring.

B. When disarming, the system shall notify the user the need to disarm the system prior to the entry delay time expiring.

7.3 REMOTE ANNUNCIATION

The system shall be able to provide entry and exit delay time period notification. This notification can be from DMP keypads, remote annunciators, or bell tests.

7.4 ABORT REPORTING

The system shall be capable of sending an Abort report to the central station if the system is disarmed while the alarm is still sounding. The Abort report shall be sent after the alarm report to notify the central station that an authorized user has cancelled the alarm.

7.5 SYSTEM TESTING

The system shall offer testing features that are simple, quick, and complete and provide the highest measure of safety by ensuring that alarm conditions are detected and communicated to the proper authorities in a timely manner and on a regularly scheduled basis.

7.6 AMBUSH CODE

The system shall offer ambush codes for those dangerous encounters where the user is instructed to either arm or disarm the system under threat of harm. The duress code shall disarm the system without giving local indication of an alarm that might put the user well-being in jeopardy.

7.7 TWO-BUTTON PANIC FEATURE

The system shall support DMP keypads that provide the option to use only two-button panic codes. The user shall be required to press and hold two designated keys for approximately two seconds before the system generates a panic alarm.

7.8 FIRE VERIFY ZONES

The system shall support Fire Verify zones to help the panel verify the existence of an actual fire condition before it sends an alarm report to the central station. The Fire Verify zone shall require the panel to perform a Sensor Reset whenever a device connected to a Fire Verify zone initiates an alarm. This shall begin a verification period during which the panel waits for a second alarm initiation. If the original zone or any other Fire Verify zone on the panel initiates an alarm within the next 120 seconds, the panel shall recognize this as an actual alarm and send an alarm report to the central station.

7.9 CROSS-ZONING PROTECTION

The system shall support cross-zoning as a means of requiring two device trips to occur within a short period of time before sounding an alarm and sending an alarm report to the central station. Supported device trips shall be from one device that trips two times, or from two devices that each trip once.

7.10 SWINGER ZONE BYPASSING

The system shall be capable of automatically bypassing a zone if it goes into an alarm or trouble condition a specified number of times within a one-hour period. The panel shall be able to track the number of times the zone trips while armed and compare that against a programmed number. When that number is reached, the panel shall be able to automatically bypass the zone. The panel shall be capable of resetting the zone when the area to which it is assigned disarms, is manually reset from the keypad or remotely, or remains normal for one hour.

7.11 RECENTLY ARMED REPORT

The system shall be capable sending a System Recently Armed report, along with a zone alarm report, to the central station any time an alarm occurs within five minutes of the system arming. The System Recently Armed report allows the central station operator to follow a “call the subscriber first” procedure instead of immediately dispatching the police to what could be a false alarm.

7.12 TRANSMIT DELAY

The system shall be capable of programming the panel to wait up to 60 seconds before sending burglary alarm reports to the central station. If an alarm is accidental, the user shall be able to disarm the system within the programmed Transmit Delay time. An Abort report shall be sent in place of an alarm report after the system disarms. During the alarm, sirens and panel relay outputs shall not be delayed and shall still provide local condition annunciation.

7.13 CALL WAITING CANCEL

The system shall be capable of being programmed to cancel call waiting any time the panel dials the receiver number to send a report.

7.14 CANCEL/VERIFY

The system shall be capable of sending either a Cancel Report or Verify Report to the Central Station to signify that the end user has Canceled an Alarm or Verified an Alarm condition. Also the system shall be programmable to instead of Cancel/Verify show "IS THIS A FALSE ALARM? NO YES". If YES send validation of alarm to Central Station, if NO send alarm cancel.

8.0 MUST MEET ANSI/SIA CP-01-2010 STANDARDS FOR FALSE ALARM REDUCTION

The system shall be capable of meeting ANSI/SIA CP-01-2010 Standards for False Alarm Reduction.

8.1 SHALL MEET EXIT DELAY STANDARDS

- Default – 60 seconds (Minimum 45 seconds)
- Progress Annunciation – different sound last ten seconds of delay
- Automatic Restart of running exit delay, one time upon re-entry
- Recent Closing – signal sent if alarm within 2 minutes of Exit time expiration (change from 5 min)
- Exit Error – Immediate local alarm and entry delay starts

8.2 SHALL MEET ENTRY DELAY STANDARDS

- Default – 30 seconds (Minimum 30 seconds)
- Pre-Warning Silenced – after first digit code entry
- Cancel Message sent if disarmed after alarm sent

8.3 SHALL MEET FAIL-TO-EXIT STANDARDS

When perimeter and exterior areas are defined and the user does not leave the building before the system arms, the system only arms the perimeter and leaves the interior unarmed

8.4 SHALL MEET AUTOMATIC RESTART STANDARDS

The system shall stop the Exit countdown once and restart it to allow the user to pick up a forgotten jacket or briefcase and exit the building without sending an alarm to the central station.

9.0 BURGLARY CONTROL SPECIFICATIONS

9.1 Burglary Standards

The Burglary system shall be listed as a Power Limited Device and be listed under the standards in the table below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings

- UL 365 Police Connect Burglar
- UL 609 Local Burglar
- UL 1023 Household Burglar Alarm System Units
- UL 1076 Proprietary Burglar
- UL 1610 Central Station Burglar Alarm Units
- UL 1635 Digital Burglar Alarm Communicator System Units

Additional Listings

- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling

U.S. Government Standards

- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

9.2 Area System

- A. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used. Each of the 574 zones shall be able to be assigned to any of the 32 available areas. The system shall be capable of having up to a sixteen (16) character length name programmed for each area.
- B. The system user shall be capable of assigning an opening and closing schedule to all areas or to each of the 32 areas separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.
- C. The networked system shall have the ability to comply with Bank Safe & Vault application. The networked system shall also have the ability to use a two-man rule for disarming or allowing door access to an area. The system shall have the ability to operate a Common Area application.

9.3 Zones

The system shall have a minimum of eight (8) grounded burglary zones available from the control panel.

9.4 Burglary Equipment

Burglary detection equipment shall communicate to the system by way of the control panel loop expansion bus or 900MHz receiver. The detection equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 9.0 of this document.

10.0 BURGLARY CONTROL SPECIFICATIONS

10.1 BURGLARY STANDARDS

The Burglary system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings	Canadian Burglary Listings
UL 1023 Household Burglar Alarm System Units	ULC C1023 Household Burglar Alarm System Units
UL 1076 Proprietary Burglar	ULC/ORD-C1076 Proprietary Burglar
UL 1610 Central Station Burglar Alarm Units	ULC S304 Central Station Burglar Alarm Units
UL 1635 Digital Burglar Alarm Communicator System Units	
U.S. Government Standards	
Meets ICD 705 Chapter 7 Intrusion Detection Systems (IDS)	
Meets DoD/NIST SCIF Standards	
Meets ANSI/SIA CP-01-2010 False Alarm Reduction	

10.2 AREA SYSTEM MODE

- A. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used. Each of the 574 zones shall be able to be assigned to any of the 32 available areas. The system shall be capable of having up to a thirty-two (32) character length name programmed for each area.
- B. The system user shall be capable of assigning an opening and closing schedule to all areas or to each of the 32 areas separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.
- C. The networked system shall have the ability to comply with Bank Safe & Vault application. The networked system shall also have the ability to use a two-man rule for disarming or allowing door access to an area. The system shall have the ability to operate a Common Area application.
- D. The Encrypted system shall have the feature of Card Plus Pin by area High security card access is provided by the Card Plus Pin feature that requires both a card read and a PIN (4-6 digit user ID) entry for arming/disarming and access by area. This Card Plus Pin operation complies with the ICPG 705 requirement for dual id authentication and operates with a DMP Prox Keypad and a HID ProxPro reader with the keypad connected to a DMP Wiegand Interface module.

10.3 HOME/SLEEP/AWAY MODE

The system shall be capable of being configured in a Home/Sleep/Away configuration for Residential applications. The system shall consist of a Main House system and up to two Guest House systems within one single control Panel with each house being controlled with its own keypad as if it were separate alarm systems.

10.4 ALL/PERIMETER MODE

The system shall be capable of being configured into the All/Perimeter configuration to enable the selective arming of both the interior and perimeter when armed "All" or arming just the perimeter devices if arming "Perimeter".

10.5 ZONES

The system shall have a minimum of eight (8) grounded burglary zones available from the control panel, and two floating ground powered zones for two wire type compatible smoke detectors. The system shall have the ability to expand using the panel's keypad bus for up to sixty-four additional zones. The system shall also have five built-in zone expansion bus (LX500 – LX900) for an additional 500 zones of expansion. The system shall have the ability to integrate up to 500 wireless zones for a total of 574 zones overall.

10.6 BURGLARY EQUIPMENT

Burglary detection equipment shall communicate to the system by way of the control panel loop expansion bus or 900MHz bi-directional spread spectrum receiver. The detection equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 11.0 of this document.

10.7 Z-WAVE EQUIPMENT

The system shall be capable of 232 Z-Wave devices by means of the use of the model 738Z module. The system shall have the capability of up to 20 Z-Wave favorites for grouping Z-Wave devices into a favorite response or control.

11.0 ACCESS CONTROL SPECIFICATIONS

11.1 ACCESS CONTROL STANDARDS

The access control system shall be listed as a Power Limited Device and be listed under the standards below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Access Control Listings	U.S. Government Standards
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UL 294 Access Control System Units	Meets ICD/ICS 705 Chapter 7 Intrusion Detection Systems (IDS)
	Meets DoD/NIST SCIF Standards

11.2 KEYPAD

- A. The system shall display a message at any keypad when any system area remains disarmed past the scheduled closing time. The message shall be displayed at one minute past the scheduled closing time. A pre-warn tone shall also begin sounding. If the system is not armed or a schedule extended within ten minutes past the scheduled closing time, the system shall provide the option of sending a Late to Close report to the central station.
- B. The keypad shall include a door strike relay capable of sending a report to the central station when activated.
- C. The keypad shall be capable of proximity arming and disarming functions.
- D. The keypad shall display red backlighting when in alarm condition notifying an individual of an unacknowledged alarm condition.
- E. The keypad shall annunciate when canceling an alarm condition the words “Cancel” or “Verify” to allow the end user the ability to cancel a user generated alarm or to select verify to send a message to the central station that the alarm has been verified by the end user and to send emergency response personnel. This is to comply with Alarm Verification.

12.0 COMPILED DETECTION EQUIPMENT LISTING

12.1 HARD-WIRED

Hard-wired detection equipment shall communicate to the system by way of the control panel loop expansion bus. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Network Transient Suppressor – DMP Model 270
- Trouble Sounder – DMP Model 277
- Bus Splitter/Repeater Module – DMP Model 710
- Door Contact – DMP Model SM-20WG (surface applications – requires DMP zone expander)
- Output Expansion Module - DMP Model 716
- Graphic Annunciator Module - DMP Model 717
- Dual Phone Line Module – DMP Model 893A

Other product types shall connect directly to zone expansion modules such as:

- Addressable - DMP Models 521LX, 521LXT, 850S/711, 850D/711
- Non-Addressable - DMP Models 521B, 521-BXT, 850S, 850D
- Addressable - DMP Model 711
- Addressable - DMP Models 714, 714-8, 714-16
- Addressable - DMP Models 712-8

- Addressable - DMP Models 715, 715-8, 715-16
- Manual Fire Alarms – DMP Models 850S, 850D

12.2 WIRELESS - NA

12.3 POWER SUPPLIES AND TRANSFORMERS

Power supply and transformer shall maintain system operation. The batteries shall be checked and replaced every three to five years. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Power Supply – DMP Model 505-12, 115 VAC, 12 VDC
- Power Supply – DMP Model 505-12LX, 115 VAC, 12 VDC
- Power Supply – DMP Model 505-12L, 12 VDC
- Transformer - DMP Model 327, 16.5 VAC 50 VA, Plug-in
- Transformer - DMP Model 322, 16.5 VAC 56 VA, Wire-in
- Transformer - DMP Model 323, 16.5 VAC 56 VA, Wire-in
- Transformer – DMP Model 324, 16.5 VAC 100 VA, Wire-in
- Transformer – DMP Model 324P, 16.5 VAC 100 VA, Wire-in

12.4 Access Control Equipment

Access control equipment shall provide access control functions between the panel and controller door access points. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Interface Module – DMP Model 733, Wiegand
- Egress Module – DMP Model PB-2 REX Button
- Reader – DMP Model MP-5365 Miniprox©
- Door Controller – DMP Model 1306P Prox Patch™
- Door Controller – DMP Model 1306PW Prox Patch™
- Access Card – DMP Model 1351 ProxPass© Card
- Access Card – DMP Model 1326 Proxcard II© Card
- Access Device – DMP Model 1346 Proxkey II™ Keyfob, 1386 Isoprox II©

13.0 INSTALLATION

13.1 SYSTEM COMPONENT INSTALLATION

Materials shall be installed in strict compliance with all local, state, county, province, district, federal and other applicable building, safety, and fire standards, laws, codes, regulations, and guidelines including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).

14.0 EQUIPMENT:

Provide the following equipment, but not limited too. Include all required material, equipment and labor for a complete operable system.

XR550N DMP SECURITY PANEL

- ◆ 32 individual reporting areas, with common areas
- ◆ Up to 16 supervised door access-points and/or keypads
- ◆ Fully supervised 10/100 network and 3G/4G cellular communication
- ◆ Communications Diagnostics check network and cellular communication status from the keypad.
- ◆ 128 Bit AES (Advanced Encryption Standard) Encryption
- ◆ Flexible system arming features, with Instant Arming option
- ◆ Card plus pin and temporary codes
- ◆ Lock Down operation from keypad or remotely
- ◆ 10,000 user codes with 99 profiles
- ◆ 506 Outputs
- ◆ 12,000 event buffer
- ◆ 1.5 Amps 12 VDC smoke and auxiliary output with OVC protection
- ◆ Two Man Rule, Panic Button Test and Early Morning Ambush

DMP KEYPAD #7070 Thinline

DMP PROXIMITY READER # MP-5365

DMP ZONE EXPANSION MODULES

- ◆ Provide 3 DMP 714-16 zone panders
- ◆ Provides Class B zones for burglary and fire
- ◆ Compatible with DMP Panels that allow zone expansion
- ◆ Suitable for mounting near protection devices
- ◆ Connect devices using 4-wire bus
- ◆ Compatible with all panel zone types
- ◆ Easy connection to 4-wire Keypad or LX-Bus™
- ◆ Proven design ensures stability and performance
- ◆ Data LED on zone expander indicates good panel communication
- ◆ Durable and attractive plastic or metal housing
- ◆ Low current draw
- ◆ Can be powered from panel or auxiliary power supply

1346/100 HID PROXKEY III ACCESS DEVICE (1 set of 100)

☐ Impact resistant construction, standard key size, and consistent read capability make the HID ProxKey III an ideal choice for an unobtrusive access device. Can be installed on key ring for convenience. Verify with the district for standards prior to bid date.

NOTE:

- ☐ All door contacts needs to be program for both security and door annunciation
- ☐ Programming of zones for the security system needs to be clarified by Special System staff.
- ☐ Programming of all the special systems needs to be approved prior to final configuration.
- ☐ Vendor must program the proxies as requested by the district.

END OF SECTION

SECTION 16741
TELEPHONE AND DATA COMMUNICATION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Division 1 Specification sections, apply to work covered by this Section.
- B. Comply with Division 16 Sections, as applicable. Refer to other Divisions for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a telephone and data communications empty conduit system, including all related systems and accessories.
- B. Refer to other sections for wiring.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with Division 1 for products specified under PART 2 - PRODUCTS.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduit, conduit sleeves, outlet boxes, cover plates and pullwire as indicated.
- B. Fireproofing material for telephone and data communication conduit and conduit sleeves through fire rated walls and floors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install telephone and data communication raceways as indicated.
- B. Install individual raceways from telephone and data communications outlets to above accessible ceiling. In areas without a ceiling, raceways shall be routed to the nearest ceiling space. In building without a ceiling, raceways shall be extended back to the main telephone/ data communication board or to a location indicated on the Drawings.
 - 1 Minimum size conduit: 1.25", provide 1 or 2-Gang box with one gang adapter, that will accept conduit size. Refer to details.
 - 2 Raceway installation shall be in accordance with Section 16130.
 - 3 Coordinate raceway installations in millwork and other fabricated architectural items with the other portions of the Work.
 - 4 Provide pullwire in each raceway tagged on each end.
 - 5 Raceways shall be terminated with an insulating bushing or a suitable connector with an insulated throat.
- C. Provide telephone and data communications outlet boxes.

- 1 Provide 1.5" 2-gang box with a one-gang mudring.
- 2 Install outlet box and device ring at each location.
- 3 Install telephone and data communications outlets at same height specified for convenience outlets unless noted otherwise. Group telephone and data communications outlets with related receptacle outlets unless noted otherwise.
- 4 Install a blank cover plate on all unused communications outlet boxes.

END OF SECTION

SECTION 16770
PUBLIC ADDRESS/INTERCOM SYSTEMS

1. SUBMITTALS

1.1. The vendor shall provide the following documentation and service:

- 1.1.1. Shop drawings: 3 sets. These drawings shall include the manufacturers' specification sheets, including all component parts.
- 1.1.2. As-built drawings: 3 sets. They should include up-to-date drawings including any changes made to the system during installation. Circuit diagrams and other information necessary for the proper operation and maintenance of the system shall be included.
- 1.1.3. All material and/or equipment necessary for the proper operation of the system, even though not specifically mentioned in the contract documents, shall be deemed part of this contract.
- 1.1.4. Provide evidence of certification by the manufacture to sell and install specified product in area.
- 1.1.5. Provide evidence of the qualifications indicated within this specification.
- 1.1.6. Provide evidence of the warranty indicated within this specifications.

2. OPERATION AND MAINTENANCE DATA

- 2.1.1. Submit operation and maintenance data under provisions of Section < >.
- 2.1.2. Include operator instructions for each required mode of operation, routine troubleshooting procedures, manufacturer's operation and maintenance manual for each item of equipment and accessory, and routine cleaning methods and materials.

3. QUALIFICATIONS

- 3.1.1. To establish continuity in manufacturer, system components shall be the standard product of one manufacturer. Further, an effort shall be made to establish common sources for equipment of all systems.
- 3.1.2. The work to be provided under this Section consists of furnishing and installing all equipment, cabling, and labor required for complete, operable, new intercommunications systems for the School < >. These systems shall be referred to as the LOW VOLTAGE SYSTEMS and their supplier as the LOW VOLTAGE CONTRACTOR.
- 3.1.3. All empty conduit and power required for the electronic systems shall be supplied by the electrical contractor as a complete raceway system. Return air plenum cable shall be used as an option at the electrical contractor's discretion. All plenum cable shall meet all applicable local and national codes.
- 3.1.4. Qualifications: The Contractor shall be from an established and locally run business which has been operating in the area for a minimum of five years. The contractor shall show evidence that he maintains a service organization and parts inventory to adequately support the supplied equipment.
The Contractor shall currently maintain a locally run business for a minimum of five years and shall be an authorized distributor of the supplied equipment with full warranty privileges. The Contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the equipment manufacturer to maintain and service the equipment being supplied. This facility shall be available for inspection by

the engineer. The supplying Contractor shall have attended the manufacturer's installation and service school.

The Contractor shall furnish manufacturer's manuals of the completed system including individual specification sheets, schematics, inter-panel and intra-panel wiring diagrams. In addition, all information necessary for the proper operation of the system must be included. Record drawings that include any changes to wiring, wiring designations, junction box labeling and any other pertinent information shall be supplied upon completion of project. Electrical components, devices and accessories: Listed and labeled as defined in NFPA 70, Article 100, b a testing agency acceptable to authorities having jurisdiction. Comply with NFPA 70. Comply with UL 50.

3.1.5. In SERVICE TRAINING:

A. 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.

B. The Contractor shall furnish a minimum of eight hours of in-service training with the system. These sessions shall be broken into segments that will facilitate the training of individuals in operating station equipment, administrative devices, user programming functions, and program distribution equipment. Operating manuals and users guides shall be provided at the time of the training.

3.1.6. The low voltage contractor must be a factory-authorized representative or distributor of all equipment used in the low voltage systems. Further, this contractor must have a minimum of five years of experience in the specific application of the equipment proposed for these systems. Provide a letter signed by an officer of the manufacturer attesting to the contractor's direct affiliation with the manufacturer.

4. REGULATORY REQUIREMENTS

4.1.1. The entire installation shall comply with all applicable electrical and safety codes. All central equipment and additional applicable equipment shall meet any required Underwriters' Laboratories, US and Canadian standards.

4.1.2. All equipment with digital apparatus (microprocessors) that generate and use timing signals at a rate in excess of 9,000 pulses per second to compute and operate must meet Federal Communications Commission (FCC) and DOC CSA standards C108.8 (Electromagnetic Emissions). Any non-compliant equipment supplied or installed shall not be accepted and shall nullify the contract.

5. MAINTENANCE SERVICE

5.1.1. The communications bidder supplying the equipment shall show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system, including replacement parts. The vendor shall be prepared to offer a service contract for the maintenance of the system after the guarantee period. The bidder shall produce evidence that they have a fully experienced and established service organization for at least five years and proven satisfactory installations during that time.

6. VOICE COMMUNICATIONS

6.1.1. Furnish and install a microprocessor-controlled integrated security and voice communications system with all conduit, wire, outlets, and equipment as shown on the

drawings and as herein specified to provide a complete sound, program distribution, and voice intercommunications system in the building.

6.1.2. Furnish and install the required number of Display Administrative Console (DA1) with all conduit, wire, outlets, and equipment as shown on the drawings.

6.1.3. All field wiring shall be standard CAT-5 type terminated with RJ45 connectors. Systems that do not use CAT-5 wire shall not be considered.

7. MANUFACTURERS:

7.1.1 All Bids shall be based on the equipment as specified herein. The CAREHAWK CH1000 The specifying authority must approve any alternate system.

a. CAREHAWK CH1000 is the basis of design.

7.1.2 The following manufactures, the contractor shall be submit with the information requested 7 days prior to bid date.

b. VALCOM Class Connect (submit data information, qualifications and warranty as indicated in specification prior to bid date for pre approval.)

c. Telecor E-Seris (submit data information, qualifications and warranty as indicated in specification prior to bid date for pre approval.)

8. SYSTEM COMPONENTS

8.1.1. A distributed, multi-channel, microprocessor-controlled security communication system. The system architecture shall allow for Security Switching Cards (SS16) that contains 16 audio ports to be remotely installed up to 2500 feet from the central cabinet. Each SS16 shall only require one CAT5 wire run back to the central cabinet. The system shall provide one independent intercom channels between any DA1 and loudspeakers. One additional simultaneously operating channel shall be provided for distribution of audio program material.

8.1.2. The system shall be capable of providing integration to third-party PBX systems over an analog CO port, allowing operators to handle calls from telephones connected to the PBX system, as well as DA1 telephone and intercom calls.

8.1.3. The system shall be capable of providing individual control of inputs from and outputs to external devices.

8.1.4. Rooms shall be equipped with call-in buttons. Call-ins from rooms shall allow for a minimum of two priority levels. Upon arrival at the designated DA1 the call shall be visually displayed and audibly annunciated. The system shall be capable of accepting up to sixteen call-in devices per SS16 circuit, each with different priorities and destination locations, over the same pair of wires.

8.1.5. The system shall have the capability for modular capacities of 256 audio ports and 8 DA1s.

8.1.6. Systems that are not capable of being distributed on a modular basis, or are not expandable or require replacement of any previously installed equipment in order to facilitate expansion shall not be acceptable.

- 8.1.7. The system shall be expandable in groups of 16 circuits by means of a Switching Security Card (SS16). Each SS16 shall be installed remotely in the area required. Each SS16 shall require only one CAT5 wire to be returned to the central cabinet.
- 8.1.8. Provide, if desired by Owner, a unique pre-announce tone to sound prior to the normal class change signal or as desired for unique events.
- 8.1.9. The system shall provide up to two non-restrictive, multiple input source program distribution channels. This functionality shall be programmed and distributed from DA1s.
- 8.1.10. The system shall have 64 user-assignable groups of stations for zoned audio paging, class change signals, or program distribution, with any station belonging to all zones, some zones, or no zone.
- 8.1.11. The system shall have a Class D digital amplifier with 125 Watt RMS output. Distortion shall not exceed 0.2% at 90% load. Class B amplifiers or amplifiers not capable of 0.2% maximum distortion will not be accepted.
- 8.1.12. The system shall use the industry-standard 25-volt methods of transmission.
- 8.1.13. Each call-in switch shall be assignable to one of two priority levels and up to 32 distinct call-in destination groups.
- 8.1.14. The system shall contain an integral master clock and programmer capable of performing the following functions:
 - 8.1.14.1.** Provide unlimited discrete time event entries for programming functions based upon:
 - 8.1.14.2.** A proper calendar that extends to the year 9999
 - 8.1.14.3.** The day or combination of days of the week and time on which the event is to occur
 - 8.1.14.4.** The selection of any one or any combination of 64 zones or six outputs to be activated
 - 8.1.14.5.** The selection of any one or combination of the unlimited schedules to allow for maximum flexibility due to special circumstances or seasonal changes
 - 8.1.14.6.** The selection of 50 user-programmable event tones
 - 8.1.14.7.** Any combination of time schedules shall be active simultaneously
 - 8.1.14.8.** The master clock shall correct compatible secondary clocks, analog or digital or both
- 8.1.15. Event tones shall be programmable from a library of 25 tone types and 25 user-added wav files.
- 8.1.16. Provide for automatic daylight saving time adjustment with leap year programming.
- 8.1.17. Provide momentary contact closures for external device operation. Provide six inputs and six outputs from the central cabinet.
- 8.1.18. Inputs shall be programmable by the installer/system administrator to initiate any desired system activity.
- 8.1.19. Outputs shall be programmable by the installer/system administrator to activate during any desired system activity.

- 8.1.20. Display the time of day shall be in either 12- or 24-hour format at each DA1.
- 8.1.21. The system central processor that controls all functions and features, shall be able to continually monitor the system's integrity. The system shall be provided with CareHawk Settings a user-friendly PC interface, Windows® based, for system programming and diagnostics. All system programming shall be done through the built-in Ethernet port on the central cabinet. The software shall support remote (off-site) system programming through the internet.
- 8.1.22. The system shall be capable of being addressed on the local LAN of the facility.
- 8.2. Display Administrative Console (DA1)
 - 8.2.1. The DA1 shall be desk-mounted or wall-mounted, and contains a matching telephone handset with retractable coiled cord and plastic button switches, with clearly designated touch points. The housing shall be constructed of high impact, flame retardant, plastic. Wall terminations shall be a RJ-45 modular telephone type jack.
 - 8.2.2. Features shall include:
 - 8.2.2.1. Large, easy-to-read, adjustable, 8 line by 20-character alphanumeric backlit LCD display
 - 8.2.2.2. Menu-driven display for ease-of-operation
 - 8.2.2.3. Handset and speakerphone
 - 8.2.2.4. Numeric 3, 4, or 5 digit dialing
 - 8.2.2.5. ADSI Capable
 - 8.2.2.6. Distinctive electronic ring signals
 - 8.2.2.7. Twelve-button key pad
 - 8.2.2.8. Soft function keys
 - 8.2.2.9. RJ12 type modular connector
 - 8.2.2.10. Call queuing
 - 8.2.2.11. Telephone-style handset
 - 8.2.2.12. Hold button
 - 8.2.2.13. Off hook LED
 - 8.2.2.14. Message waiting LED
 - 8.2.2.15. 200 Speed dials
- 8.3. ROOM CALL BUTTON
 - 8.3.1. *CareHawk* Model CS100 Call Station
 - 8.3.1.1. Call-in switch with call and emergency.
 - Switch type: One silicon pushbutton non mechanical vandal resistant.
 - Designation: CALL screened on the pushbutton
 - Finish: Brushed stainless steel
 - Mounting: Flush to a one-gang back box no more than 2" (5.1 cm) deep
- 8.4. External PBX/KSU INTERFACE
 - 8.4.1. The PBX/KSU interface shall be provided through any of the eight TC1 Ports to any PBX/KSU analog C.O. ports.

- 8.4.2. The interface connection to a PBX/KSU shall be made from a TC1 to a PBX/KSU extension to allow any system telephone to have access to the PBX/KSU.
- 8.4.3. The interface connection from the PBX/KSU shall be made from the PBX/KSU extension port to an extension.
- 8.4.4. This shall allow PBX/KSU telephones to have access to system extension features.
- 8.4.5. This shall allow call-ins to be routed from speaker stations to the PBX/KSU attendant console.

9. SYSTEM FEATURES

- 9.1.1. The system shall provide user-programmable room number assignment.
- 9.1.2. The system shall provide 3, 4, or 5-digit numeric format for architectural room numbering and an alpha-numeric caller ID description associated with each room in the event of a call in.
- 9.1.3. The dialing sequence shall incorporate full numeric capabilities as available on industry-standard telephone key pad.
- 9.1.4. The DA1 shall allow the user to view the numeric room address and the caller ID information of the calling station and the call priority (e.g., emergency, normal). The DA1 shall use distinctive ringing patterns to annunciate the type of call.
- 9.1.5. The system shall contain a minimum of 64 multipurpose zones that can be assigned and programmed as desired between paging, program, or time zones.
- 9.1.6. The system shall provide for a minimum of 25 distinct user-programmable system tones and 25 user-added wav files.
- 9.1.7. The following programmable system tone events shall be available:
 - 9.1.7.1.** Emergency page pre-announce
 - 9.1.7.2.** Page pre-announce
 - 9.1.7.3.** Door tone
 - 9.1.7.4.** Intercom pre-announce
 - 9.1.7.5.** Privacy tone
- 9.1.8. Paging shall originate from any DA1, PBX phone dedicated paging microphone, or program source input.
- 9.1.9. The system shall include page or intercom priority over class change tones and preprogrammed events. Class change tones occurring simultaneously with an all page or zone page shall have priority.
- 9.1.10. Communications with each classroom loudspeaker shall be hands-free. The staff member or occupant in the classroom need not operate any buttons to reply to a call. The DA1 operator shall use the hands-free speaker phone or handset on the DA1.

- 9.1.11. A mute button shall be provided on the DA1 to allow the operator to mute the outgoing conversation as desired.
- 9.1.12. All audio functions in the system shall operate within the following priority scheme:
 - 9.1.12.1.** A lower priority function shall not interrupt a higher priority event.
 - 9.1.12.2.** A lower priority event shall be interrupted by a higher priority event.
 - 9.1.12.3.** Interrupted lower priority functions (automatic) shall be restored after conclusion of the higher priority function. If an event is initiated while a page is occurring, the event shall be delayed until the page is complete.
- 9.1.13. The system shall allow each loudspeaker to be a member of up to 64 multipurpose zones.
- 9.1.14. In rooms provided with a privacy switch, the system shall incorporate all necessary circuitry to prevent overhearing conversations in any room equipped with a loudspeaker. The privacy switch shall have a visual indicator to confirm the privacy setting. The DA1 shall provide the user with an indication that the classroom privacy switch is in the privacy mode.
- 9.1.15. The caller shall be able to change a normal call-in to an emergency call at any time.
- 9.1.16. The system shall distinguish between an emergency call and a normal call from any station, and automatically route each type of call-in to a DA1.
- 9.1.17. The system shall also include provisions to allow call-in coverage to be redirected to an assigned coverage group manually (using call forwarding).
- 9.1.18. Normal and emergency priority levels shall provide a distinctive call-in ring with a programmable cadence.
- 9.1.19. Calls routed to the appropriate DA1 destination group's call-in queue shall be placed in the order of priority and time of origination. When a call-in occurs to a specific call destination group, the call-in shall ring at all DA1s in the assigned group. Any telephone within the group shall be able to answer the call. Telephones not within the call group can also answer using a dial code. The call-in then shall be answered at any DA1 by dial code.
- 9.1.20. Calls routed to the DA1 shall display the incoming caller's room number along with the total number of calls within the call-in queue. Calls can be scrolled by the DA1 using the arrow keys for selective answering of intercom calls. If the DA1's queue has a high priority or emergency call-in present a calling telephone shall receive a busy signal.
- 9.1.21. When a system port is dialed from the DA1, the dialed number and caller ID information shall appear in the DA1 display window.
- 9.1.22. DA1 calls to other telephones shall ring the appropriate telephone and be connected when the called party goes off-hook.
- 9.1.23. The system shall allow any telephone to place an emergency voice paging announcement.
- 9.1.24. The DA1s shall be capable of, but not restricted to, the following:

- 9.1.24.1.** Extension-to-extension direct dialing
 - 9.1.24.2.** Extension-to-speaker station direct dialing
 - 9.1.24.3.** Call on hold
 - 9.1.24.4.** Call transfer
 - 9.1.24.5.** Paging
 - 9.1.24.6.** Tone distribution
 - 9.1.24.7.** Preprogrammed speed dialing
 - 9.1.24.8.** Call forwarding
- 9.1.25. A group of loudspeakers shall be temporarily excluded from receiving time tone signals, non-emergency page, or program distribution by designating the desired stations as excluded stations from a preprogrammed zone.
- 9.1.26. The system shall allow a group of loudspeakers to be permanently excluded.
- 9.1.27. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules.
- 9.1.28. The system shall allow pre-selected program material to be distributed according to preprogrammed schedules.
- 9.1.29. The DA1 shall provide the following functions and features:
- 9.1.29.1.** User-programmable architectural room number assignment using three, four, or five digit numeric, direct dialing number assignment. Any DA1 shall direct dial any other telephone, loudspeaker, or group of loudspeakers.
 - 9.1.29.2.** The DA1 shall employ state-of-the-art hard plastic switches requiring no mechanical or spring contacts. The switches shall provide the operator with positive feel and tactile response, and shall be sealed and impervious to moisture or liquids.
 - 9.1.29.3.** The DA1 shall be equipped with a large adjustable 8 line by 20 character backlit LCD alphanumeric readout that provides the following:
 - 9.1.29.3.1.** *Queuing of calling room numbers and telephones along with caller-ID information*
 - 9.1.29.3.2.** *Displaying calls waiting sequentially, no limit to number of calls*
 - 9.1.29.3.3.** *Displaying emergency, priority, and normal calls, first in order of priority, and then by order received*
 - 9.1.29.3.4.** *Displaying the numeric room number and caller ID information of the calling station, telephone, or call-in switch*
 - 9.1.29.3.5.** *Displaying time, day, and date when phone is not in use*
 - 9.1.29.3.6.** *Display menus to allow selection of zones, program sources, and other user functions without the use of long numeric codes.*
 - 9.1.29.4.** A standard telephone handset with a coiled cord shall be provided to allow private two-way communications with other telephones.
 - 9.1.29.5.** The DA1 shall provide two modes of communication to classroom loudspeakers. Communications shall be via handset or speakerphone.

- 9.1.29.6.** Call-ins shall be answered by picking up the handset.
- 9.1.29.7.** Call-in from DA1s or classroom call-in buttons shall be displayed in the following manner:
- 9.1.29.7.1.** *The first call entered shall appear in the display window of the responsible DA1s, which shall display the dial number and caller ID information of the calling station.*
 - 9.1.29.7.2.** *Any number of calls shall be stored in memory, up to the total capacity of the system with the quantity of those calls waiting displayed at the DA1.*
 - 9.1.29.7.3.** *Normal and lower level calls shall annunciate with different cadence compared to emergency calls. Calls shall sort and stack automatically according to the preprogrammed priority level assignments. Each incoming call shall be automatically registered first in order of priority, then by order placed.*
 - 9.1.29.7.4.** *Calls that have been upgraded by the caller shall automatically move to the emergency level and appear in proper sequence.*
 - 9.1.29.7.5.** *High priority level calls shall annunciate with a faster ring cadence.*
 - 9.1.29.7.6.** *Emergency calls are distinguishable from normal calls by designation and unique cadence pattern. Attendant shall visually or audibly determine whether the call-in from a classroom is an emergency or normal call-in.*
- 9.1.29.8.** A DA1 shall have the ability to forward its call-in coverage to other DA1s. All functions such as all page, zone page, and other programmed functions shall be available to all DA1s.
- 9.1.29.9.** It shall be possible to manually activate and sound the time tone event signal to any of the 64 multipurpose zones from any DA1.
- 9.1.29.10.** A program menu shall be provided on each DA1 for selection and distribution of each of the program channels to classroom and other loudspeakers.
- 9.1.29.11.** The program channels shall be distributed via the DA1 to a room or rooms, corridor loudspeakers, paging zones, or all rooms.
- 9.1.29.12.** Changes to the distribution of the programs shall be initiated while program distribution is already in progress.
- 9.1.29.13.** Provide capability for any DA1 to transfer a call to another DA1.
- 9.1.30. Each classroom port shall be programmed with a 3, 4, or 5 digit numeric dial number and caller ID information. Each classroom shall be equipped with up to eight call-in switches per port. Two user-programmable priority levels are available to each room call-in button and up to 32 call-in destination groups.
- 9.1.31. To place a normal call, momentarily press the call button. To upgrade to an emergency call, press the call button twice with in two seconds.
- 9.1.32. Normal calls shall be automatically upgraded (at any time) to an emergency call by pressing the call button for twice with in two seconds.

END OF SECTION

SECTION 17200
IN-CEILING CLASSROOM AUDIO SYSTEM

1.1 REGULATORY REQUIREMENTS

- A. Conform to (applicable) (specify specific citations) building code for requirements applicable to work specified herein.
- B. Conform to appropriate sections of (specify) with regard to applicable requirements (specify).

1.2 QUALITY ASSURANCE

- A. Qualifications
 - 1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 - a. Certificate: when requested, submit certificate, indicating qualification.
 - 2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.
- B. Acceptable Manufacturers
 - 1. Basis of Design: Lightspeed Technologies, 11509 SW Herman Road, Tualatin, OR 97062, PH 800-732-8999, FAX 503-684-3197.
- C. Manufacturer Testing: Manufacturer to provide quality assurance certification for each system and all of its components. A report for each system will be available upon request. Report will include serial numbers and pertinent testing data for all of the system functions.
- D. Successful third party installation (when needed) will be supplied with necessary training to allow for product installation certification by Manufacturer and will be installed according to Lightspeed recommendations.

1.3 SUBMITTALS

- A. General: Submit listed submittals in accordance with “Conditions of the Contract”.
- B. Manufacturer’s data on all products including but not limited to:
 - 1. Catalog cut sheets
 - 2. Installation instructions
 - 3. Typical wiring diagrams
 - 4. Drawings showing speaker locations
 - 5. Daily Use Guide
 - 6. Manufacturer’s warranty documents
 - 7. Manufacturer’s parts lists
 - 8. Product serial numbers

1.4 WARRANTY

- A. Warranty: Refer to “Conditions of the Contract” for warranty and repair provisions.
- B. Repair: Manufacturer shall offer repair service on all Classroom Audio components. Owner shall pre-pay shipping for all items returned to manufacturer for repair. The Manufacturer shall repair or replace system components as specified under warranty. Manufacturer shall ship

repaired components within five (5) working days of receipt. Items returned to Owner are shipped via the same method in which they were received.

- C. Manufacturer's Warranty: All the major system components (transmitters, receiver-amplifier and speakers) must be warranted for five years against defects occurring while used in normal classroom instruction. The warranty shall be equivalent to a Lightspeed Technologies' Five-Year Warranty.
 - 1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1.5 OVERALL SYSTEM DESCRIPTION

- A. The system must have specifications and features that are equivalent to the Lightspeed Topcat Access™ In-Ceiling Classroom Audio System including the following:
 - 1. All-in-one, in-ceiling audio system with integrated amplifier, speakers and wireless audio receiver/transmitter
 - 2. Two-way hybrid speaker system with exciter technology sound panel and low frequency cone driver
 - 3. Cross over technology to deliver high speech intelligibility and full range sound with even distribution throughout the classroom
 - 4. Up to 2 microphones for whole room instruction, team-teaching or student sharing
 - 5. Pendant-style Flexmike™ classroom microphone with audio input utilizing Access Technology (1.9 GHz) for transmission. IR not acceptable
 - 6. Optional PageFirst emergency page priority
 - 7. In-Ceiling mounted
 - 8. Suitable for use in air-handling spaces (plenum-rated)
 - 9. Wireless Media Connector utilizing Access Technology (1.9 GHz) to integrate with and wirelessly transmit all classroom multimedia to be played through the Topcat
 - a. Includes 4 audio inputs with volume control
 - b. 2 audio outputs for ALD and/or recording with volume control
 - c. Tone control to remotely adjust bass/treble of Topcat
 - 10. Alternative Activate Charging Station with Access Technology, Bluetooth and Wireless Media Connectivity for integration with mobile devices and laptops:
 - a. Includes 2 channels of 2-way Bluetooth Audio
 - b. 4 audio input connections, 2 audio outputs with volume controls
 - c. Cradle charging for 2 pendant microphones, eight (8) 2-way audio Pods
 - d. USB ports to charge up to four (4) additional 2-way audio Pods
 - d. Bluetooth connection with Activate mobile app for control, streaming and audio/video recording of classroom instruction and interaction.
 - e. Mobile device control of system volume levels, Activate Pod selection, and advanced system settings
 - 11. Optional Activate Pods with 2-way audio communication featuring the following functionality:
 - a. Integrated speaker and microphone to enable 2-way communication between the teacher and each small group
 - b. Wireless audio communication and battery power for maximum portability
 - c. Up to 12 speaker Pods can be connected to Topcat for each small student group
 - d. Enables student sharing directly from the Pods so students can be clearly heard by the whole class
 - e. Must include a call button allowing students to notify the teacher when they need assistance

12. Optional handheld remote control to select and direct communication with small Activate Pods volume levels when mobile device is not present
- B. The amplifier must contain a Page mute function (PageFirst™) that passively detects the audio signal of a page coming through the PA system without compromising system performance or voiding warranties. As an audio signal is sent to the PA speaker, the PageFirst™ detects that signal and immediately mutes the Topcat audio amplifier.
- C. The system must produce high speech intelligibility and full-range multimedia quality sound with excellent distribution throughout a classroom.
- D. The system must be capable to be installed in a classroom with no wires installed in or on the walls. The system must be fully operational without speaker wires or sensor cables.
- E. The system must be compatible and expandable to operate with 2-way small group speaker Pods allowing interoperability between both small group and whole group instruction.
- F. The system shall carry a “No Audio Dropout Guarantee” between the wireless microphone and the sound system. The guarantee applies to operation in any room up to its expected range of 200 feet (assuming no walls). The guarantee does not extend into other rooms separated by walls as this can limit transmission range significantly. Should any dropout within the classroom in audio transmission occur, the manufacturer would correct it at no additional charge.
- G. The system shall carry a standard warranty equivalent to the Lightspeed 5-year Warranty.

1.6 OWNER INSTRUCTION

- A. Owner’s Instruction: user training will be performed by the manufacturer’s local representative. The training will include the research and benefits of classroom amplification, system operation, simple troubleshooting guidelines, and incorporating the classroom amplification into teaching styles. The manufacturer will also provide additional training in trouble-shooting techniques and product return procedures to one specified person per campus. This service shall be rendered to the Owner at no additional cost.
- B. A Daily Use Guide is included with system to provide information on how to use the system. In addition, instruction materials and detailed Owner's manual shall be available on manufacturer’s website to cover complete operational and basic maintenance procedures.

PART 2. PRODUCTS

2.1 IN-CEILING CLASSROOM AUDIO SYSTEM SPECIFICATIONS

- A. Overall System:
 1. Power output: 20 Watts RMS
 2. Acoustic Frequency response: 60 Hz to 18 kHz -10dB
 3. AC Mains Power Input: 100-240V ~ 50/60Hz 1.5A
 4. DC Power Input: 24V/2.5A
 5. Signal-to-noise: 60 dB
 6. Total Harmonic Distortion: <1%, 10 W
 7. Wireless Communication: Access Technology (1.9 GHz + RF4CE)
 8. Automatic power on when Flexmike is powered on and linked

9. Dimensions (W x D x H): 24" x 12" x 3.7" (Removable side spacers to fit international ceiling grids; 595mm x 295mm x 94mm)
 10. Weight: 13.5 lbs. (6.1 kg)
 11. Controls:
 - a. (1) Microphone volume control
 - b. (1) Tone control
 - c. (1) Audio input volume control
 - d. (1) PageFirst sensitivity adjustment
 12. Connections:
 - a. (1) Direct AC mains power input
 - b. (1) Optional DC Power Input
 - c. (1) Audio input (Longer cable runs may require a ground loop isolator in order to prevent audio hum caused by a ground loop.)
 - d. (1) Optional Page mute (PageFirst™) input (Euro-block)
 13. Device Registration: push button for transmitter(s), remote(s), speaker Pods, Media Connector, Activate Station
 14. Wireless audio range: up to 200 feet
 15. Integrated 2-Way Hybrid Speaker System:
 - a. Description: exciter technology sound panel plus low frequency cone driver
 - b. Integrated cross-over technology
 - c. Panel Size: 13.75" x 6.75"
 - d. Cone Driver Size: 5.25"
 - e. Overall Frequency Response: 60 Hz to 18 kHz -10dB
 - f. Impedance: 8 Ω
 - g. Power Handling: 25 W
- B. The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to communicate with up to two wireless microphones.
 - C. The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to integrate with other audio sources in the classroom.
 - D. The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to send a mixed audio output to a media connector or Activate Station located at a convenient/student accessible location in the classroom.
 - E. The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to communicate with up to 12 optional tabletop speaker Pods available to facilitate small group instruction.
 - F. The all-in-one system must contain a Page mute function (PageFirst™) that passively detects the audio signal of a page coming through the PA system without compromising system performance or voiding warranties. As an audio signal is sent to the PA speaker, the PageFirst passive sensor clip detects that signal and immediately mutes the Topcat.

2.2 FLEXMIKE PENDANT-STYLE MICROPHONE / TRANSMITTER

- A. Description: the pendant-style Flexmike transmitter shall contain microphone volume control on the unit allowing users to adjust volume level from anywhere in the classroom. The Flexmike shall be capable of being worn around a teacher's neck as a hands-free microphone via the lavalier cord or to be used as a handheld student pass-around microphone. The Flexmike must

be rechargeable via cradle charger, computer, or Activate Bluetooth Charging Station and must have alkaline charge protection.

- B. Lanyard: adjustable length with magnetic clasp
- C. Wireless communication: bi-directional Access Technology (1.9 GHz)
- D. Audio distortion: <1%
- E. Integrated microphone type: uni-directional electret
- F. Audio input: 3.5mm
- G. Earbud output: 3.5mm (for monitoring optional Activate Pods)
- H. Push button volume control: +/- 6dB (total range = 12 dB)
- I. Power: on/off/mute button
- J. Battery Power: 2.4V NiMH battery pack
- K. Battery run time: 8 hours (fully charged)
- L. Charging: Integrated battery charger. The 5V power can be supplied via a cradle charger (charges two Flexmike transmitters)
- M. Alkaline Charge Protection: Yes
- N. USB Audio: interface with computer USB audio while charging
- O. Registration: push button for registration with Topcat
- P. Dimensions (L x W x H): 2.9" x 1.1" x 1.0" (74 x 28 x 25mm)
- Q. Weight: 1.8 oz. (51g)

2.3 OPTIONAL SHAREMIKE HANDHELD MICROPHONE / TRANSMITTER

- A. Description: handheld wireless microphone for student pass-around use
- B. Wireless communication: Access Technology (1.9 GHz)
- C. Audio distortion: <1%
- D. Integrated microphone type: uni-directional electret
- E. Auxiliary Input: 3.5mm
- F. Power: on/off/mute button
- G. Battery Power: 2 AA NiMH rechargeable battery pack
- H. Battery run time: up to 8 hours (fully charged)
- I. Charging: 5V USB; 3.5mm DC jack
- J. Alkaline Charge Protection: Yes
- K. Registration: push button for registration with Topcat
- L. Dimensions (L x W x H): 8.25" x 1.3" x 1.3"
- M. Weight (with batteries): 7.9 oz.

2.4 WIRELESS MEDIA CONNECTOR

- A. Description: Wireless audio transmitter/receiver to integrate with classroom audio sources and send/receive the wireless to the Topcat system in the ceiling.
- B. Wireless Communication: Access Technology (1.9 GHz)
- C. Audio Inputs: (4) 3.5mm stereo jacks connect to classroom audio sources.
- D. Audio Outputs: (2) 3.5mm jack with volume control
- E. (1) Microphone volume control
- F. (1) Audio input volume control
- G. (1) Audio output volume control
- H. (1) Power button with LED
- I. (1) Tone control
- J. (1) Registration button with Registration LED and linked LED
- K. Audio frequency response: 80 Hz to 7 kHz ± 3 dB
- L. Audio distortion: <1%
- M. DC Power Input: USB 5V/0.2A (type micro-B)
- N. Mounting: table-top or wall
- O. Dimensions (W x D x H): 7.6"x 4.1"x 1.1" (193 x 104 x 28mm)

2.5 ALTERNATIVE ACTIVATE CHARGING STATION WITH ACCESS TECHNOLOGY, BLUETOOTH AND WIRELESS MEDIA CONNECTIVITY

- A. Description: Device charging station with wireless audio and Bluetooth connectivity. Activate utilizes 2-way audio communication to integrate audio sources and mobile devices with Topcat in the ceiling.
 - 1. Integration with Activate mobile app for control, streaming and audio/video recording of classroom instruction and interaction.
 - 2. Mobile device control of system volume levels, Activate Pod selection, and advanced system settings.
- B. Mobile app functionality: Bluetooth interface with companion mobile application with the following functionality:
 - 1. Control and connect to small group 2-way audio Pods
 - 2. Adjust system audio levels and tone control
 - 3. Mobile device audio streaming from audio books, podcasts, music, etc.
 - 4. Audio/video recording synched with microphone and Pod audio
 - 5. Enable advanced system features
- C. Wireless Communication: Access Technology (1.9 GHz + RF4CE), Bluetooth audio (2 channels), Bluetooth LE (2 channels)
- D. Wireless range: Up to 200 ft. (60m) from Topcat, up to 100 ft. (30m) from mobile device.
- E. Audio frequency response: 80 Hz to 7 kHz ± 3 dB
- F. Audio distortion: <1%
- G. Cradle charging: 2 Flexmikes; 8 Pods

- H. USB charging ports: Two (2) 5V/0.3A charging for Pods, remotes, or Sharemikes; Two (2) 5V/1.0A charging for mobile devices or Pods.
- I. DC Power Input: 24V/1.75A
- J. Auxiliary Power Input: 5V USB from portable power source (no device charging)
- K. Audio Inputs: (4) 3.5mm stereo jacks with volume control
- L. Bluetooth Audio: (2) independent 2-way Bluetooth audio channels
- M. Audio Outputs: (2) 3.5mm jack with volume control
- N. Volume controls: Master microphone, audio input, audio output with 10-segment level indicator
- O. Device Pairing: (2) Push buttons for Bluetooth device pairing, (1) push button for Access device registration.
- P. Mounting: table-top
- Q. Dimensions (W x D x H): 13.3"x 5.9"x 1.9" (340 x 150 x 52mm)
- R. Weight: 1.85 lbs. (0.84kg)

2.6 OPTIONAL 2-WAY AUDIO PODS FOR SMALL GROUPS

- A. Description: 2-way audio Pod with integrated speaker and microphones. Up to 12 Pods can be connected to a single audio system.
- B. Wireless Communication: Access Technology (1.9 GHz)
- C. Wireless range: Up to 200 ft. (60m) from Topcat; up to 100 ft. (30m) with walls
- D. Integrated speaker: 1" high output speaker
- E. Power output: 1 Watt per Pod speaker
- F. Integrated microphones: Two (2) Omni-directional electret with noise rejection
- G. Headphone output: 3.5mm
- H. Controls: Power on/off button, volume up/down buttons, teacher call button
- I. Battery power: 2.5V NiMH rechargeable battery pack
- J. Battery charging: 2 contact for cradle charging + 5V/0.3A micro-USB
- K. Battery life: 10+ hours (fully charged)
- L. Dimensions: 5.2" x 2.1" x 1.1" (132 x 54 x 28mm)
- M. Weight: 6.4 oz. (181g)

2.7 OPTIONAL HANDHELD REMOTE (1-2)

- A. Description: Handheld remote control to select and direct communication with small student groups
- B. Battery Power: 2.4V NiMH battery pack
- C. Charging: 5V USB
- D. Wireless communication: Access Technology (RF4CE)
- E. Controls: Pod selection 1-6; whole class selection; microphone mute; earbud volume

- F. Registration: push button and LED for registration with Topcat
- G. Dimensions (L x W x H): 4.25" x 2.0" x 1.0" (108 x 51 x 25mm)
- H. Weight: 3.4 oz (98g)

2.8 REGULATORY AND CERTIFICATIONS

- A. The classroom audio system and its components shall be manufactured using lead-free processes and free of other materials harmful to the environment (RoHS and WEEE compliant).
- B. The classroom audio system and its components shall be listed to UL/CUL standards and requirements for electrical safety by Underwriters Laboratories Inc.
- C. The classroom audio system must be suitable for use in air handling spaces and carry appropriate certifications (UL 2043).
- D. The classroom audio system and its components shall be CE Certified and conform with the essential requirements of the following European Union Directives: 2014/30 EU Electromagnetic Compatibility (EMC), 2014/35/EU Low Voltage Directive (LVD) and RED 2014/53/EU.
- E. The classroom audio system and its components shall comply with Part 15 of the FCC rules as a Class B digital device (FCC Certified).

PART 3. EXECUTION

3.1 SYSTEM PERFORMANCE

- A. Install in accordance with Manufacturer's installation instructions.
- B. Final adjustment: Upon completion, the system shall be clean, adjusted and left in perfect operating condition. Transmitters shall be plugged in and charging and Daily Use Guide should be left in a conspicuous place. The full user manual shall be available for download from the manufacturer's website.
- C. Provisions: There shall be no audible components of hum, noise, or distortion.

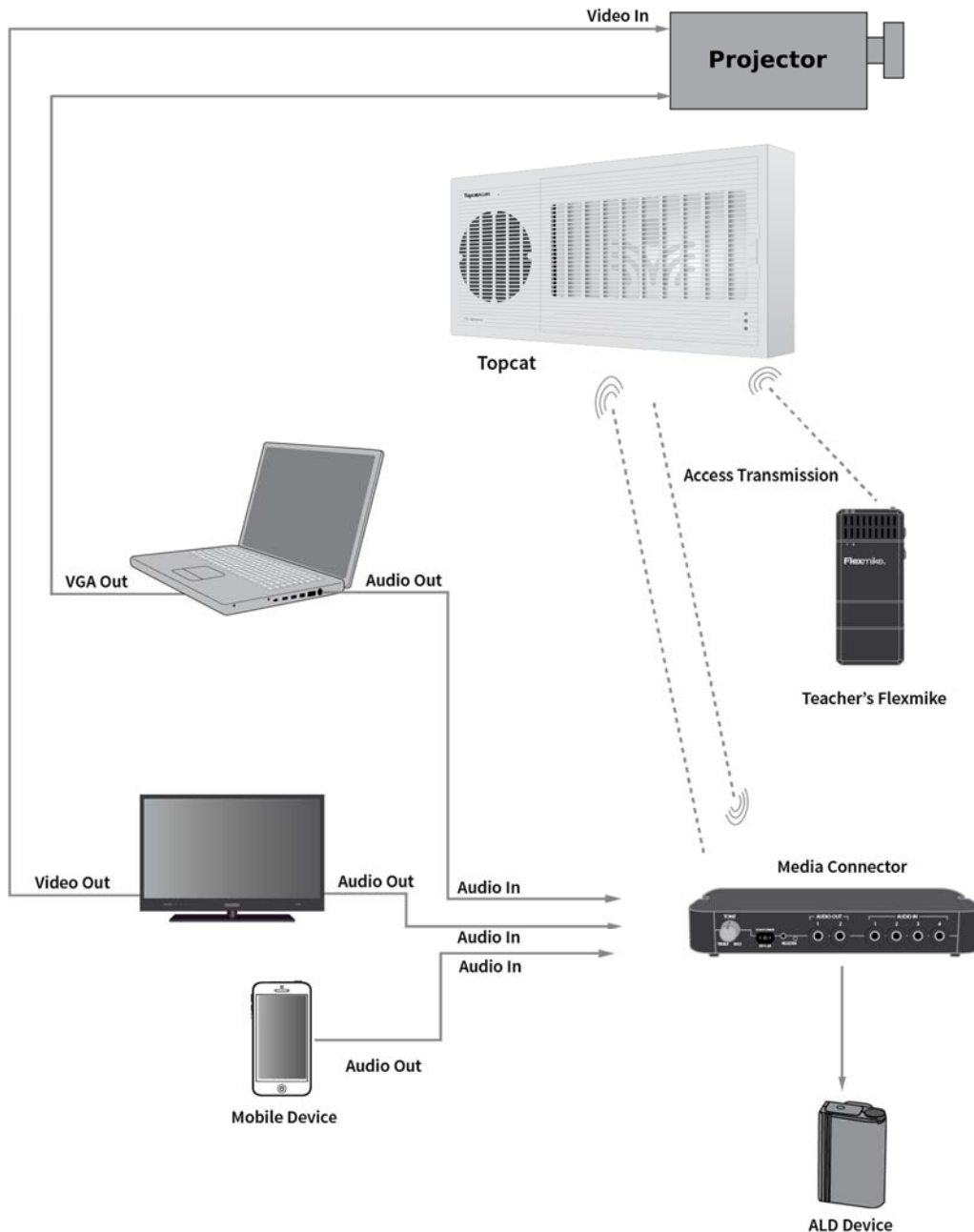
3.2 INSTALLATION

- A. Provide and install Sound Reinforcement System in the locations shown on drawings as required.
- B. All equipment and enclosures described in this specification shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads per manufacturers specifications.
- C. The process of testing the Audio Sound System may necessitate moving and adjusting certain component parts (ex. loud speakers). Contractor shall provide at no additional cost to the owner.
- D. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic noise interference. Long cable runs, unshielded and / or poorly shielded cable, multiple ground paths and improper grounding may all contribute to the production of a low frequency hum. In most cases a ground loop isolator (not provided) placed in line will attenuate or possibly eliminate the hum.
- E. Wireless Media Connector or Activate Charging Station shall be located per Owner's request. Contractor to ensure all Media Connectors or Activate Charging Stations have power available,

are properly registered, and all volume controls are set properly via a field test in every classroom.

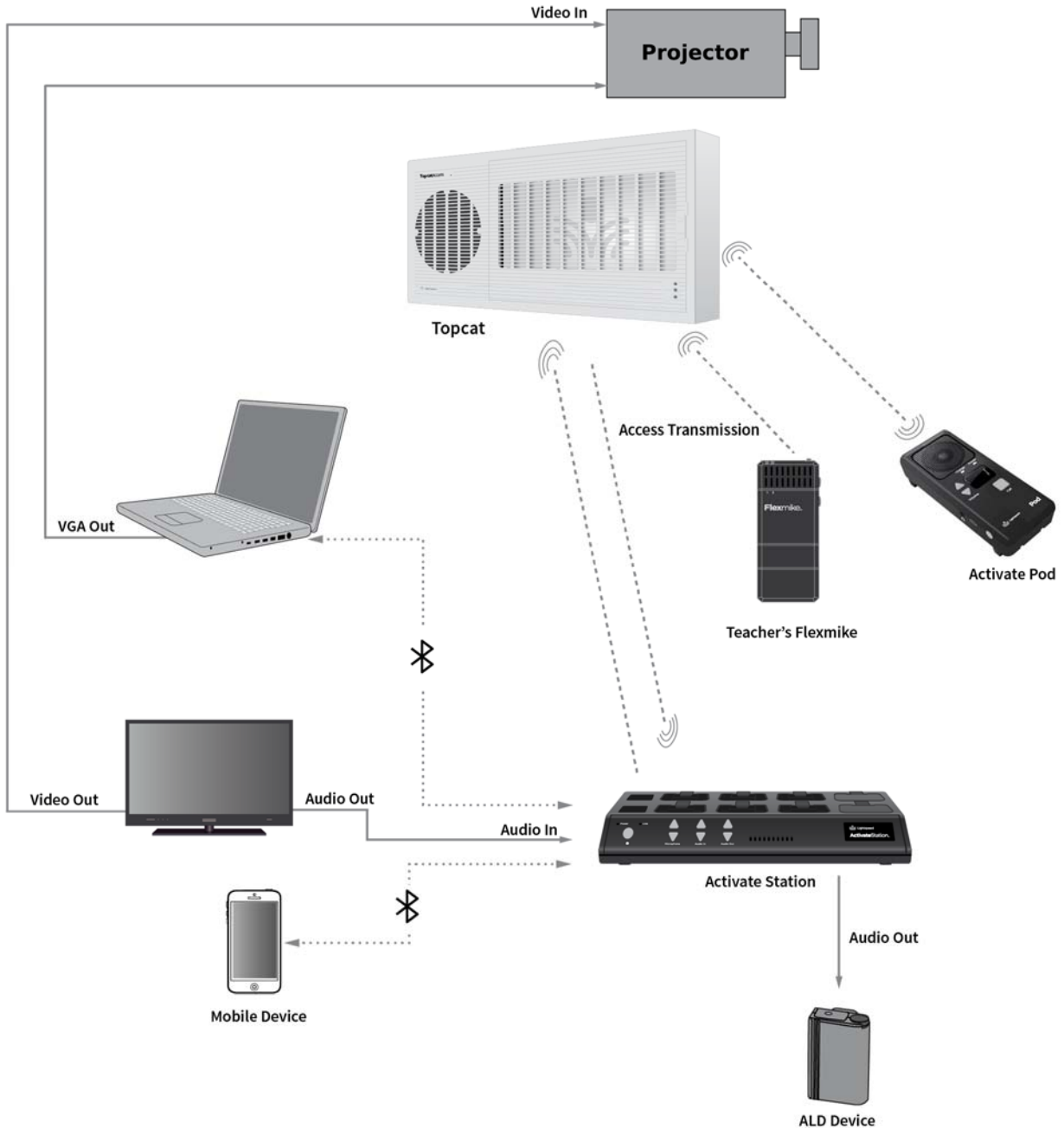
3.3 TOPCAT AUDIO INTEGRATION USING MEDIA CONNECTOR

The wireless Media Connector must have four audio inputs to allow other audio sources to be wirelessly transmitted and played through the Topcat system. Computers, laptops, DVD/VCR's, LCD displays, etc. may be connected into the Media Connector using appropriate patch cords. The Media Connector must also receive audio back from the Topcat to output the mixed audio signal of both microphone channels and multimedia for recording purposes and interface with assistive listening devices. See the systems integration chart below.



3.4 TOPCAT AUDIO INTEGRATION USING ACTIVATE STATION

The wireless Activate Station must have four audio inputs plus 2 Bluetooth audio channels to allow other audio sources to be wirelessly transmitted and played through the Topcat system. Computers, laptops, mobile devices, DVD/VCR's, LCD displays, etc. may be connected into the Activate Station via Bluetooth or using the appropriate patch cable. The Activate Station must also receive audio back from the Topcat to output the mixed audio signal of both microphone channels as well as selected Pods for audio/video recording to the mobile device and interface with assistive listening devices. Activate Station must also communicate with mobile devices via Bluetooth LE for selection and control of small group audio Pods and system volume levels.



END OF SECTION