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PROJECT MANUAL

**HIDALGO COUNTY, TEXAS
PRECINCT No. 4**

NEW JUSTICE CENTER

EDINBURG, TEXAS

JOB: 2018.19

SET
NO.

PROJECT MANUAL

***HIDALGO COUNTY, TEXAS
PRECINCT No. 4***

NEW JUSTICE CENTER

EDINBURG, TEXAS

PROJECT NO. 2018.19



2/5/21

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".

ROFA ARCHITECTS INC.

1007 WALNUT AVENUE

McAllen, TEXAS 78501

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PROJECT MANUAL

**HIDALGO COUNTY, TEXAS
PRECINCT NO. 4
NEW JUSTICE CENTER
EDINBURG, TEXAS**

Project No. 2018.19

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12-10-20

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December 10, 2020

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12-10-20

12/10/2020



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12/10/2020



DIVISION 21 – FIRE PROTECTION

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28 46 21.11 ADDRESSABLE FIRE-ALARM SYSTEMS



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23 37 13 DIFFUSERS, REGISTERS AND GRILLES
23 74 10 PACKAGED ROOFTOP UNITS

DIVISION 26/27/28 –ELECTRICAL

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28 31 00 INTRUSION DETECTION
28 46 21.11 ADDRESSABLE FIRE-ALARM SYSTEMS

SECTION 00220

SOIL INVESTIGATION DATA

PART 1: GENERAL:

1.01 SUBSURFACE SOIL INVESTIGATION:

- A. Subsurface borings have been taken at the Project Site and a Final Report on Foundation Soil investigation has been prepared.
- B. The information was obtained for use in preparing the foundation design, but is indicative only of the soil conditions where the boring is taken.
- C. Bidders are expected to examine the site and the record of investigation to determine character of materials to be encountered.
- D. If soil conditions other than those indicated are encountered during construction, notify the Architect before work continues.
- E. Complete reports are available at the office of the Architect and may be examined there.

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 **FIFTY THOUSAND (\$50,000.00) 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.

END OF SECTION

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.

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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 City of **Edinburg** 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 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 off 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

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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 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 City of **Edinburg** 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.

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 2012 or latest edition. 2009 Energy Conservation Code.
21. NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS:/CURRENT EDITION
22. INTERNATIONAL PLUMBING CODE – 2012 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 – 2012 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 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 applications on original AIA DOCUMENT G702 - Application and Certificate for Payment. Use AIA DOCUMENT G703 for Architect approval of itemized schedule of values. Forms can be downloaded via www.lrgv.org/documents/.
- 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 any change to Contract Sum or Allowance and description, executed prior to the date of submission, at the end of the continuation sheets unless otherwise agreed upon.
- 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) notarized, original AIA – G702 Application and Certificate for Payment to Architect at the times agreed upon in Pre-Construction meeting.
- 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 monthly or bi-weekly Architect Owner Contractor (AOC) meetings, and special called meeting throughout the progress of the project.
 - 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. Architect shall schedule a Pre-Construction meeting within fifteen (15) days after date of Notice to Proceed.
- B. Location: RIKE-OGDEN-FIGUEROA-ALEX ARCHITECTS INC.
1007 Walnut Avenue, McAllen, Texas 78501
- C. Attendance:
 - 1. Owner's Representative.
 - 2. Architect and his professional consultants.
 - 3. Contractor's project manager and superintendent.
 - 4. Major Subcontractors.
 - 5. Others as appropriate.

1.03 PROGRESS MEETINGS:

- A. Schedule regular bi-weekly or monthly meetings at **a scheduled time** on an agreed upon date.
- B. Hold called meetings as required by progress of the Work.
- C. Location of the meetings: on site or designated meeting place.
- D. Attendance:
 - 1. Owner representative.
 - 2. Architect and his professional consultants needed.
 - 3. Contractor's project manager and superintendent.
 - 4. Subcontractors and suppliers as appropriate to agenda.
 - 5. 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 7 days prior to THE SUBMITTAL OF THE GUARANTEED MAXIMUM PRICE.***

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's 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 7 days prior to SUBMITTING GUARANTEED MAXIMUM PRICE.***
- 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:
- 3 months to 6 month projected completion 1 month from date of contract for items requiring color selection and 2 months for other items.*
- 7 months to 12 month projected completion 2 months from date of contract for items requiring color selection and 3 months for other items.*
- 13 months to 16 month projected completion 3 months from date of contract for items requiring color selection and 4 months for other items.*
- over 17 months projected completion 4 months from date of contract for items requiring color selection and 5 months for other items.*
- 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.

SECTION 01330
CONSTRUCTION PROGRESS DOCUMENTATION

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.
- 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 01152.

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
- 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 backcharged 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.
- 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 7 days prior to submittal of guaranteed maximum price.**
- 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.
- C. A request for a substitution constitutes a representation that Contractor:

SECTION 01631
SUBSTITUTIONS AND PRODUCT OPTIONS

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. General Contractor to provide the following:
 - 1.) 5 DVD sets containing PDF files, organized in a PDF portfolio, containing all pertinent information in this section and related sections. File naming and organization should be as per Rike Ogden Figueroa Allex Architect's Closeout Document - Electronic Submission Form (attached).
 - 2.) 1 Set of hard copies in binders divided into tap sections organized and named in the same way as folders are in the electronic submissions.
 - 3.) AS-BUILT drawings and specifications incorporating all addenda's, approved change proposals/change orders, Architectural Supplemental Instructions (ASI), and Request For Information (RFI).

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 10 working days of 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:
 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.) List of all subcontractors and suppliers organized by specification section
- B.) Contractor's Release of Lien
Provide AIA Document G707 and G706A
- C.) Subcontractor's release of liens waiver.
- D.) One Year Warranties – General and Subcontractors
- E.) Meeting Notes: Refer to requirements of Section 1720 – Project Record Documents
- F.) Submittals organized by specification section: Refer to requirements of Section 1720 – Project Record Documents
- G.) Construction Photographs organized by month: Refer to requirements of Section 1720 – Project Record Documents
- H.) All City and/or County Inspections

- I.) All Substantial Completion & Punchlists
- J.) All Certificate of Occupancy
- K.) Contractor's Asbestos Free Affidavit Letter; Refer to requirements of Section 1800 – General Notes
- L.) Keying Schedule; Refer to requirements of Section 08710 - Finish Hardware
- M.) Training Sign-In Sheets with signatures of attendees
- N.) HVAC Test and Balance Report
- O.) Product Warranties organized by specification section; Refer to requirements of Section 1740 Warranties and Bonds
- P.) Operating and Maintenance Data organized by specification section; Refer to requirements of Section 1730 – Operating and Maintenance Data
- Q.) Material Testing; Refer to requirements of Section 1720 – Project Record Documents
- R.) Material Safety and Data Sheets (MSDS) of products organized by specification section.

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.

1.08 CLOSEOUT DOCUMENTS – ELECTRONIC SUBMISSION FORMAT:

A. Contractor shall submit 5 DVD's, each DVD with the following information and format:

Folder Name: 01 List of Subcontractors

- Filename: *List of Subcontractors.pdf*

Folder Name: 02 Contractor's Payment and Release of Liens

- Filename: *AIA – G706A Contractor's Affidavit of Release of Liens.pdf*
- Filename: *AIA-G707 – Consent of Surety to Final Payment Form.pdf*

Folder Name: 03 Subcontractor's payments & release of liens waiver.

- Filename: *Release of Lien – Company Name.pdf*

Examples:

Release of Lien - EMI

Release of Lien - D&J Site Utilities

Conditional Release of Liens are acceptable when retainage is still pending. Conditional release should explicitly say release of liens upon receiving retainage.

Folder Name: 04 One Year Warranties – General and Subcontractors

- Filename: *One Year Warranty – Company Name.pdf*

Examples:

One Year Warranty – Spawglass.pdf

One Year Warranty – D&J Site Utilities.pdf

Folder Name: 05 Meeting Notes

- Filename: Date – *Meeting Agenda.pdf*
- Filename: Date – *Meeting Notes.pdf*

Examples:

2016.03.03 – Meeting Agenda.pdf

2016.03.03 – Meeting Notes.pdf

Folder Name: 06 Submittals

- Filename:
Specification Number – Specification Name – Shop Drawings.pdf
Specification Number – Specification Name – Data Sheets.pdf

Examples:

08740 – Access Control Systems – Shop Drawings.pdf

11131 – Motorized Projection Screens – Data Sheets.pdf

Folder Name: 07 Construction Photographs

Note: All photos need to be submitted in .JPG format.

Sub-Folder: Year - Month

- Filename of photograph: Year – Month – Date - #.jpg

Examples:

2016 – 03 – 01 – Photo 1.jpg

2016 – 03 – 01 – Photo 2.jpg

Folder Name: 08 City – County Inspections

- Filename: *Inspection - Type.pdf*

Examples:

Inspection - Underground Plumbing.pdf

Folder Name: 09 Substantial Completion & Punchlists

- Filename: *Substantial Completion.pdf*
If more than one Substantial Completions are used in the project, such as different buildings, file naming should be as follows:
- Filename: *Substantial Completion – Building Name.pdf*
Building Name is the actual name of the building
Examples:
Substantial Completion – Administration.pdf
Substantial Completion – Gymnasium.pdf
- Filename: *Punchlist - Entity.pdf*
Entity is the actual name of the entity performing the punchlist
Examples:
Punchlist – Architect.pdf
Punchlist – Owner.pdf
Punchlist – MEP.pdf

Folder Name: 10 Certificate of Occupancy

- Filename: *Certificate of Occupancy.pdf*
If more than one Certificate of Occupancies are used in the project, such as different buildings, file naming should be as follows:
- Filename: *Certificate of Occupancy – Building Name.pdf*
Building Name is the actual name of the building
Examples:
Certificate of Occupancy – Administration.pdf
Certificate of Occupancy – Gymnasium.pdf

Folder Name: 11 Contractor's Asbestos Free Affidavit Letter

- Filename: *Contractor's Asbestos Free Affidavit.pdf*

Folder Name: 12 Keying Schedule

- Filename: *Keying Schedule.pdf*
Provide date of key transfer meeting.

Folder Name: 13 Training

- Filename: *Specification Number – Specification Name – Sign-In.pdf*
Examples:
08740 – Access Control Systems – Sign-in.pdf
11131 – Motorized Projection Screens – Sign-in.pdf
15950 – Building Automatic Controls – Sign-in.pdf

Folder Name: 14 HVAC Test and Balance Report

- Filename: *Project Name – HVAC Test and Balance Report.pdf*

Folder Name: 15 Product Warranties

- Filename: *Specification Number – Specification Name – Warranty.pdf*
Examples:
07535 – Fully Adhered Multi-Ply Roofing System - Warranty.pdf
15732 – Rooftop Units – Warranty.pdf

Folder Name: 16 Operating and Maintenance Data.

SECTION 01700
CONTRACT CLOSEOUT

- Filename: *Specification Number – Specification Name – Maintenance or Manual.pdf*
Examples:
10100 – Markerboards and Tackboards – Maintenance.pdf
15732 – Rooftop Units – Operating Manual.pdf

Folder Name: 17 Material Testing

Note: Please use sub-folders to separate different tests, such as compaction, concrete, grout, welding, asphalt, etc.

Sub-Folder: Compaction

- Filename as per testing laboratory

Sub-Folder: Concrete Breaks

- Filename as per testing laboratory

Sub-Folder: Grout

- Filename as per testing laboratory

Folder Name: 18 Material Safety and Data Sheets

- Filename: *Specification Number – Specification Name – MSDS.pdf*
Examples:
09260 – Gypsum Drywall – MSDS.pdf
09300 – Tiling – MSDS.pdf

Sample Folder Hierarchy



END OF SECTION

SECTION 01710
CLEANING

PART 1: GENERAL:

1.01 DESCRIPTION:

- A. Execute cleaning, during progress of the Work, and at completion of the Work, as required by General Conditions.

1.02 DISPOSAL REQUIREMENTS:

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2: PRODUCTS:

2.01 MATERIALS:

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3: EXECUTION:

3.01 DURING CONSTRUCTION:

- A. Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations or his subcontractor's operations. Oversee cleaning and ensure that building and grounds are maintained free from accumulations of waste materials and rubbish.
- B. At reasonable intervals during progress of work, clean up site, building and access, and dispose of waste materials, rubbish and debris. Provide containers and locate on site for collection of waste materials, rubbish and debris. Do not allow waste materials, rubbish and debris to accumulate and become an unsightly or hazardous condition.
- C. Transport waste materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces. Sprinkle dusty debris with water.
- D. Burning or burying of rubbish and waste materials on the project site is not permitted. Disposal of volatile fluid wastes (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems is not permitted. Remove waste materials, rubbish and debris from the site and legally dispose of at public or private dumping areas off the Owner's property.
- E. Contractor shall coordinate efforts to properly protect new and existing material from damage by ongoing construction work.

3.02 FINAL CLEANING:

- A. At completion of construction and just prior to acceptance or occupancy conduct a final inspection of exposed surfaces. Perform final cleaning and maintain cleaning until building, or portion thereof, is accepted by Owner.
- B. Remove dirt stains, labels, fingerprints and other foreign materials from surfaces. Repair marred surfaces to match adjacent finishes.
- C. Remove all waste materials and rubbish from and about the Project as well as all tools, construction equipment, machinery and surplus materials.

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.
 - 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 and identify in DVD PDF files, organized in a PDF portfolio with index.
- 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.
 6. Manufacturer's printed operating and maintenance instructions.

SECTION 01730
OPERATING AND MAINTENANCE DATA

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 technics.
- 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. See attached.

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, 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

SECTION 01800
GENERAL NOTES

Superseded General Decision Number: TX20160305

State: Texas

Construction Type: Building

County: Hidalgo County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	04/14/2017
2	09/08/2017

BOIL0074-003 01/01/2017

	Rates	Fringes
BOILERMAKER.....	\$ 28.00	22.35

ENGI0178-005 06/01/2014

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
(1) Tower Crane.....	\$ 29.00	10.60
(2) Cranes with Pile Driving or Caisson Attachment and Hydraulic Crane 60 tons and above.....	\$ 28.75	10.60
(3) Hydraulic cranes 59 Tons and under.....	\$ 27.50	10.60

* IRON0084-011 06/01/2017

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 23.27	7.12

PLUM0412-004 04/01/2013

	Rates	Fringes
PLUMBER.....	\$ 31.14	12.43

SUTX2014-031 07/21/2014

	Rates	Fringes

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GENERAL NOTES

BRICKLAYER.....	\$ 16.17	0.00
CARPENTER.....	\$ 14.21	2.22
CEMENT MASON/CONCRETE FINISHER...	\$ 12.46	0.00
ELECTRICIAN.....	\$ 18.44	4.53
INSULATOR - MECHANICAL (Duct, Pipe & Mechanical System Insulation).....	\$ 11.54	2.17
IRONWORKER, REINFORCING.....	\$ 12.01	0.00
IRONWORKER, STRUCTURAL.....	\$ 15.04	4.34
LABORER: Common or General.....	\$ 8.00	0.00
LABORER: Mason Tender - Brick...	\$ 10.00	0.00
LABORER: Mason Tender - Cement/Concrete.....	\$ 10.89	0.96
LABORER: Pipelayer.....	\$ 11.00	3.47
LABORER: Roof Tearoff.....	\$ 10.06	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 14.04	1.01
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 13.93	0.00
OPERATOR: Bulldozer.....	\$ 18.29	1.31
OPERATOR: Drill.....	\$ 16.22	0.34
OPERATOR: Forklift.....	\$ 14.83	0.00
OPERATOR: Grader/Blade.....	\$ 10.00	0.00
OPERATOR: Loader.....	\$ 12.87	0.70
OPERATOR: Mechanic.....	\$ 17.00	0.00
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 16.03	0.00
OPERATOR: Roller.....	\$ 12.70	0.00
PAINTER (Brush, Roller, and Spray).....	\$ 11.27	0.00
PIPEFITTER.....	\$ 15.22	3.16
ROOFER.....	\$ 11.42	0.00
SHEET METAL WORKER (HVAC Duct Installation Only).....	\$ 18.40	2.12
SHEET METAL WORKER, Excludes HVAC Duct Installation.....	\$ 21.13	6.53

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GENERAL NOTES

TILE FINISHER.....	\$ 11.22	0.00
TILE SETTER.....	\$ 12.15	0.00
TRUCK DRIVER: Dump Truck.....	\$ 12.39	1.18
TRUCK DRIVER: Flatbed Truck.....	\$ 19.65	8.57
TRUCK DRIVER: Semi-Trailer Truck.....	\$ 12.50	0.00
TRUCK DRIVER: Water Truck.....	\$ 12.00	4.11

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

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

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)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198

indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

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

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GENERAL NOTES

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 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

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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 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

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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.
- 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.

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- 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.
- D. Dispose of all waste materials not burned by removal from site.

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- 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 * * ***

SECTION 02110
SITE PREPARATION

PART 1: GENERAL:

1.01 SUMMARY:

- A. Section Includes:
 - 1. Protection or removal of trees and other vegetation.
 - 2. Topsoil stripping.
 - 3. Clearing and grubbing.

1.02 RELATED REQUIREMENTS:

- A. Construction drawings.

1.03 JOB CONDITIONS:

- A. Provide protection necessary to prevent damage to existing improvements, trees, or vegetation indicated on the Contract Documents to remain.
- B. Protect improvements on adjoining properties and on Owner's property.
- C. Restore damaged improvements to original condition as acceptable to parties having jurisdiction.
- D. Conduct site clearing operations to ensure minimum interference with roads, 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. Streets and roadways shall be thoroughly cleaned and/or swept on a daily basis or more frequently as required by the governing authority.
- E. Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the State Highway Department requirements.

PART 2: PRODUCTS:

- A. This part not used.

PART 3: EXECUTION:

3.01 SUMMARY:

- A. Unless otherwise indicated on the Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Do not remove items elsewhere on site or premises unless specifically indicated.
- B. Strip topsoil to whatever depths encountered to prevent intermingling with underlying subsoil or other objectionable material. Cut heavy growths of grass from areas before stripping. Topsoil shall consist of sandy clay surficial soil found in depth of not less than 6". Topsoil shall be reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.
- C. Stockpile topsoil in storage piles in areas shown or where directed. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable as specified

SECTION 02110
SITE PREPARATION

for waste material, unless otherwise specified by Owner. Excess topsoil shall be removed from the site by the Contractor unless specifically noted otherwise on the Drawings.

- D. Completely remove stumps, roots, and other debris below proposed subgrade elevation. Fill depressions caused by clearing and grubbing operations with satisfactory soil materials, unless further excavation or earthwork is required. Place fill material in horizontal layers not exceeding 8" loose depth, and thoroughly compacted per fill requirements of this section and Section 02210.
- E. Remove existing above grade and below grade improvements and abandoned underground piping or conduit necessary to permit construction and other work.

END OF SECTION

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.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

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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
- C. ASTM D4355 - Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

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- 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 periodic 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:

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- 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.

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

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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.

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:

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- 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

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.

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- 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.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

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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:

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.

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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:

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.

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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.
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.

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- 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.

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.

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- 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:
 - 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

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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.
 - 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.

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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.

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, 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.

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- 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).

2.03 TYPES:

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- 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:

<u>TEST</u>	<u>TESTING PROCEDURE</u>
Preparation for soil constants and sieve analysis	TEX-101-E
Liquid Limit	TEX-104-E
Plastic Limit	TEX-105-E
Plasticity Index	TEX-106-E
Sieve Analysis	TEX-110-E
Wet Ball Mill	TEX-116-E

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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 Crushed or. Broken Aggregate (excluding gravel aggregate)	Retained on % Sq. Sieve 1-3/4".....0 7/8".....10-35 3/8".....30-50 No. 4.....45-65 No. 40.....70-85 Max LL.....35 Max PI.....10 Wet Ball Mill Max Amt 40 Max Increase in Passing No. 40.....20	Retained on % Sq. Sieve 1-3/4".....0-10 No. 4.....45-75 No. 40.....60-85 Max LL.....40 Max PI.....12 Wet Ball Mill Max. Amt.....50 Max Increase in Passing No. 40.....20	Retained on % Sq. Sieve 1-3/4".....0-10 No. 40.....60-85 Max LL.....45 Max PI.....15 Wet Ball Mill Max Amt.....55 Max Increase in Passing No. 40.....20	As Shown on Plans
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	As Shown On Plans

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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	As Shown on 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- nace Slag			As Shown on 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.

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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 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

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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 recompacting 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 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

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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".

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- 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 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.

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- 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.

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.

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- 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.
- 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 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,

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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.

PART 3 - EXECUTION

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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.
- 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.

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- 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 of the forward group, mounted in a rigid frame, and provided with a loading platform or body suitable for ballast loading.

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- 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.
- F. The roller, when drawn or propelled by any type of equipment, shall be considered a medium pneumatic tire roller unit.

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- 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.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

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- 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 produces the desired results as would be expected of the specified equipment as determined by the ENGINEER, its use shall be discontinued.

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 all MC materials shall be straight run asphalt produced within the penetration range of

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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

* 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.

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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.
 - 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.

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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.

PART 4 - MEASUREMENT AND PAYMENT

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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 * * ***

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

SECTION 02281
TERMITE CONTROL

not be permitted due to its susceptibility to capillary absorption by concrete and its ability to damage adhesives, 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

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SECTION 02510 - CONCRETE CURB AND GUTTER AND VALLEY GUTTER

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION OF WORK:

- A. This work shall consist of the construction of concrete curb, concrete curb and gutter, concrete gutter or valley gutter, or combination thereof in compliance with the specifications, lines, grades, and details shown on the plans, or as directed by the ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Concrete and manufactured curb and gutter materials shall be subject to inspection and tests at plants and construction sites for compliance with quality requirements.
- B. Concrete curb and gutter or concrete valley gutter shall be constructed with concrete conforming to the provisions of Section 02614 - Portland Cement Concrete Paving, or Class "B" concrete conforming to the requirements of Section 03300 - Cast-In-Place Concrete.
- C. Preformed expansion Joint Filler shall conform to the requirements of AASHTO M-33 or M-153.
- D. Linseed Oil shall conform to the requirements of AASHTO D-260.
- E. Mineral Spirits shall conform to the requirements of AASHTO D-235.

2.02 FOUNDATION:

- A. Concrete curb and gutter or concrete valley gutter shall be placed on an approved foundation conforming to the requirements of the following Specifications:
 - 1. Section 02210 - Subgrade Preparation,
 - 2. Section 02223 - Flexible Base,
 - 3. Section 0223 - Roadway Excavation, Borrow, and Embankment.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. When required, excavation shall be made to the specified depth, and the base upon which the curb and gutter or valley gutter is to be placed shall be compacted to a firm, even surface conforming to the requirements of Subsection 2.02 above.
- B. All soft and unacceptable material shall be removed and replaced with material approved by the ENGINEER in conformance with the requirements of Subsection 2.02 above.

3.02 FORMS:

- A. Forms shall be of wood or metal, straight, free from warp, and of such construction that facilitates the inspection of the grade and alignment for compliance with the approved plans and specifications.
- B. All forms shall extend for the entire depth of the curb and gutter and shall be braced and secured sufficiently so that no deflection from alignment or grade will occur during the placement of the concrete. Flexible forms shall be used in curved sections so that the top surface of the forms will form a smooth, continuous arc.

3.03 MIXING AND PLACING:

- A. Concrete shall be proportioned, mixed, and placed in accordance with the requirements of Section 02614 and Section 03300.
- B. Compaction of the concrete placed in forms shall be by vibration or other acceptable methods.
- C. Unless otherwise provided, the exposed surfaces of curbs and gutters shall be finished by belting or with wooden floats. Forms shall be left in place until the concrete has set sufficiently so that they can be removed without injury to the curb and gutter.

3.04 SECTIONS:

- A. Curb and gutter shall be constructed in sections having a uniform length of 20 feet, unless otherwise directed by the ENGINEER. Except at expansion joints, sections shall be separated by open joints 1/8 inch wide.

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3.05 EXPANSION JOINTS:

- A. Expansion joints shall be formed at the intervals shown on the plans using a preformed expansion joints filler having a thickness of 3/4 inch.
- B. When the curb and gutter or concrete valley gutter is constructed adjacent to an existing concrete pavement, an expansion joint shall be located between the curb and gutter section and the existing concrete pavement.

3.06 CURING

- A. Immediately upon completion of the finishing, the curb and gutter shall be moistened and kept moist for 3 days, or the curb and gutter shall be cured by the use of a membrane-forming material. The method and details of curing shall be subject to the approval of the ENGINEER.

3.07 SURFACE TREATMENT:

- A. The surface of concrete curb and gutter or concrete valley gutter shall be treated with a solution of Linseed Oil and Mineral Spirits in accordance with the applicable requirements of Section 03300 - Cast-In-Place Concrete.

3.08 BACKFILLING:

- A. After the concrete has set sufficiently, the spaces in front and behind the curb and gutter section shall be refilled to the required elevation with material approved by the ENGINEER, and shall be thoroughly tamped in layers of not more than 6 inches.

3.09 SLIP-FORM CONCRETE CURB, CONCRETE CURB AND GUTTER OR CONCRETE VALLEY GUTTER:

- A. Any concrete curb or concrete curb and gutter, except on structures, may be placed using a slip form machine provided that the finished concrete curb or concrete curb and gutter is true to line and grade, the concrete is dense, and of the required surface texture.
- B. The concrete shall be of a consistency that it will maintain the shape of the concrete curb or concrete curb and gutter section without support after slip forming.

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- C. The top and face of the finished concrete curb or concrete curb and gutter shall be true a straight and the top surface of the concrete curb or concrete curb and gutter shall be of uniform width and free from humps, sags, or other irregularities.
- D. The forming portion of the slip form machine shall be readily adjustable vertically during the forward motion of the slip form machine to provide a variable height of concrete curb or concrete curb and gutter grade when necessary. A grade line gauge or pointer shall be attached to the slip form machine in such a manner that a continual comparison can be made between the concrete curb or concrete curb and gutter grade as indicated by the offset guidelines.
- E. Concrete shall be fed to the slip form machine at a uniform rate. The slip form machine shall be operated under sufficient uniform restraint to forward motion to produce a well compacted mass of concrete free from surface pits larger than 3/16 inch in diameter and requiring no further finishing, other than light brushing with a wet brush. Finishing with a brush application of grout will not be permitted.
- F. Transverse weakened planes and expansion joints shall be constructed at right angles to the line of the concrete curb, concrete curb and gutter, or concrete valley gutter.
- G. Expansion joints may be constructed by sawing through the concrete curb or concrete curb and gutter section to its full depth. The width of the cut shall be such as to admit the joint filler with a snug fit.
- H. The operations of sawing and inserting the joint filler shall be completed before curing the concrete. At the conclusion of the curing period the filler in each joint shall be checked for tightness of fit. Loose filler in any joint shall be mortared in place and cured.
- I. Excavation shall be as per Subsection 3.02 above.
- J. All remaining provisions of Subsection 2.02 above also apply, unless otherwise specified.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

- A. Curb and gutter, curb, and valley gutter shall be measured by the linear foot.
 - 1. Curb shall be measured along the front face of the section at the finished grade elevation.
 - 2. Combination curb and gutter will be measured along the face of the curb at the flowline of the gutter.

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3. Valley gutter will be measured along the flowline of the gutter.
- B. A deduction in length shall be made for drainage structures, such as catch basins or inlets, in the curb, gutter, or combination thereof.
- C. There will be no direct measurement or payment of materials used to construct curb and gutter, curb, or valley gutter.
- D. Excavation or construction of embankment for foundation of curb, valley gutter, or combination curb and gutter will not be measured for payment.

4.02 PAYMENT:

- A. The accepted quantities of curb, valley gutter, and curb and gutter will be paid for at the contract unit bid price per linear foot for each kind and type specified, complete and in place.
- B. Foundation preparation by excavating or constructing embankment to the required subgrade elevation is considered incidental to the completion of the work and no direct payment will be made thereof.
- C. Compensation 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 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.
 - 1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

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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 produce 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'.
- C. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

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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 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.

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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.

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- 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.
- 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:

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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:
 - 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:

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- 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.
 - 4. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

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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.
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

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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 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

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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, 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.

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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

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.

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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 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.

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- 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 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:

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- 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.
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.

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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:
 - 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.

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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.
- 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

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- 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 rise with cast in place manhole bases may be installed after foundation concrete has attained 75% of design strength.
- 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.

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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 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.

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- 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.
- 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.
- 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

- 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 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:

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- 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 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.

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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

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 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

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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 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-

* Procedure No. 1 with CCl₄ substituted for CS₂.

** Using 85% Standard Naphtha Solvent and 15% Xylene.

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

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Test on 85 to 115 Pen.Residue* -- -- -- -- 75 --
Residue by Wt., %

Ductility, 77° F, 5 cm/min:
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.

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	--

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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/cm2

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

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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
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

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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
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

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5. Type "F" - Fine Graded Surface Course

	Percent Aggregate by Weight or Volume
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

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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 it 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:

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- 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%
Passing No. 80 Sieve	75%

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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
Passing No.200 sieve	± 3

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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:

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- 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, tine 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:

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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

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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

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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:

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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:

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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,

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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

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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.

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	*

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* 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.
- 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:

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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.
- 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.

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- 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 be 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.
- D. The accepted quantities of special complete structures shall be paid at the unit bid price per each.

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- 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 * * ***

SECTION 02584 -PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 DESCRIPTION

This work shall consist of furnishing and applying paint on pavement, curb and sidewalk surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Texas Manual on Uniform Traffic Control Devices published by the Texas Department of Transportation for details not shown.

1.02 SUBMITTALS

- A. In accordance with Section 01340, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.

1.03 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
TT-P-1952D Paint, Traffic Black, and Airfield Marking, Waterborne
- C. Master Painters Institute (MPI):
Approved Product List - 2016

PART 2 - PRODUCTS

2.01 PAINT

Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

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2.02 REFLECTIVE GLASS BEADS

—Beads shall conform to Fed. Spec. TT-B-1325C, Type I, Gradation A. When used in regions of high humidity, coat beads with silicone or other suitable waterproofing material to assure free flow. Furnish the glass beads in containers suitable for handling and strong enough to prevent loss during shipment. A certificate shall accompany each batch of beads stating compliance with this section.

2.03 PAINT APPLICATOR

Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. // If the equipment does not have a glass bead dispenser, use a separate piece of equipment. Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. // An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

2.04 SANDBLASTING EQUIPMENT

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m³/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing

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paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

3.02 APPLICATION

Apply uniformly painted pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

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3.03 PROTECTION

Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

3.04 DETAIL PAVEMENT MARKING

Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends.

3.05 TEMPORARY PAVEMENT MARKING

When shown or directed by the Resident Engineer, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Resident Engineer, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted marking. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted markings at no additional cost to the Government.

3.06 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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	(1981; Errata) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In. for Water.

1.1.1 Piping for Water Distribution Lines 3 Inches or Larger

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.

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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 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.

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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 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.

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 D1784 - 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 153 - 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:

- 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.

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- 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 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.

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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.

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- 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.
 - 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.

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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.

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.

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- 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.
 - 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

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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:

- 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.

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END OF SECTION

SECTION 02721 HIGH-DENSITY POLYETHYLENE PIPE (HDPE)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section includes construction of high-density polyethylene pipe for storm drainage culverts including appurtenances normally installed as a part of these systems. Construction may include surface preparation, trench excavation, shoring, dewatering, lay, align, and join pipe, installation of appurtenances, bedding and backfilling, surface restoration, and other related work.

1.2 RELATED SECTIONS

- A. The following is a list of SPECIFICATIONS, which may be related to this section:
 - 1. Section 02150, Temporary Erosion & Sediment Control for Construction
 - 2. Section 02102, General Clearing and Grubbing.
 - 3. Section 02110, Site Clearing.
 - 4. Section 02100, Site Preparation
 - 5. Section 02221, Trench Excavation, Backfill, and Compaction.

1.3 REFERENCES

- A. The following is a list of standards, which may be referenced in this section.
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
 - b. M294, Standard Specification for Corrugated Polyethylene Pipe.
 - c. Section 18, Soil Thermoplastic Pipe Interaction Systems.
 - 2. ASTM International (ASTM):
 - a. D638, Standard Test Method for Tensile Properties of Plastic.

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- b. D1056, Specification for Flexible Cellular Materials - Sponge and Expanded Rubber.
 - c. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - d. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - e. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
 - f. D4976, Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - g. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - h. F667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.
 - i. F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
 - j. F2306, Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
 - k. F2562, Specifications for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage.
 - l. F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and fittings.
3. Plastic Pipe Institute (PPI):
- a. Handbook of Polyethylene Pipe.
 - b. TR-33, Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

1.4 SUBMITTALS

- A. Details of fittings and specials shall be furnished for approval by ENGINEER.
- B. Unless otherwise specified, CONTRACTOR shall submit to ENGINEER for approval SHOP DRAWINGS showing the exact dimension of the joints including the permissible tolerances for each size of pipe being furnished and the size, type and locations of gasket materials. Approval of the joint detail DRAWINGS shall not

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relieve CONTRACTOR of any responsibilities to meet all of the requirements of these SPECIFICATIONS, or of the responsibility for correctness of CONTRACTOR's details.

CONTRACTOR shall submit certified laboratory test certificates for all items required in this section.

- C. CONTRACTOR shall cooperate with ENGINEER in obtaining and providing samples of all specified materials.

1.5 QUALITY ASSURANCE

A. Manufacturer:

1. Experienced in the design, manufacture, and commercial supplying of the specific material for a minimum period of five (5) years.
2. Experienced in the design, manufacture, and commercial supplying of the specific size of pipe for a period of one (1) year.
3. Certify to above minimum experience requirements.

- B. All HDPE pipe and fittings shall be from a single manufacturer. All HDPE pipe to be installed may be inspected at the factory for compliance with these SPECIFICATIONS by an independent testing laboratory provided by the OWNER. The CONTRACTOR shall require the manufacturer's cooperation in these inspections. The cost of these plant inspections of all pipe approved, plus the cost of inspection of a reasonable amount of disapproved pipe, will be borne by the OWNER.

- C. Inspection of the pipe shall also be made by the ENGINEER or other representatives of the OWNER after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the SPECIFICATION requirements, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Responsibility for Material:

1. Shipping: Material shall be shipped so to not cut, kink, or otherwise damage pipe during transport.
2. CONTRACTOR shall be responsible for all materials intended for the WORK that are delivered to the construction site and accepted by CONTRACTOR. Payment shall not be made for materials found to be defective or damaged in handling after delivery and acceptance. Defective or damaged materials shall be removed and replaced with acceptable materials at CONTRACTOR's expense.
3. CONTRACTOR shall be responsible for the safe and proper storage of such

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materials.

- a. Limit stacking of pipe to a height that will not cause excessive deformation of bottom layers of pipes under anticipated temperature conditions.
 - b. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.
 - c. Keep pipe shaded from direct sunlight prior to installation in the trench.
- B. Pipe Acceptance:
1. In addition to any deficiencies not covered by the applicable ASTM Specifications, pipe, which has any of the following visual defects, will not be accepted.
 - a. Cracks, bubbles, pinholes, inclusions or occlusions, which, because of their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe.
- C. Pipe Handling:
1. Pipe and accessories furnished by CONTRACTOR shall be delivered to, unloaded, and distributed at the site by CONTRACTOR. Each pipe shall be unloaded adjacent to or near the intended laying location.
 2. Pipe fittings, specials, valves, and appurtenances shall be unloaded and stored in a manner that precludes shock or damage. Such materials shall not be dropped.
 3. Pipe shall be handled to prevent damage to the pipe ends or to any coating or lining. Pipe shall not be skidded or rolled against adjacent pipe. Damaged coatings or lining shall be repaired or replaced by CONTRACTOR, at CONTRACTOR's expense in accordance with the recommendations of the manufacturer and in a manner satisfactory to Engineer. Physical damage to the pipe or accessory shall be repaired or replaced by CONTRACTOR at CONTRACTOR's expense, and in a manner satisfactory to ENGINEER.
- D. Gasket Storage: All gaskets shall be stored in a cool place, preferably at a temperature of less than seventy degrees Fahrenheit (70°F.), and in no case shall the gaskets be stored in the open, or exposed to the direct rays of the sun.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: HDPE pipe, which does not conform to ASTM D3350, ASTM D 4976, ASTM F667, ASTM F894, ASTM F2306, or ASTM F2562 or to any other requirement specified herein, shall not be approved for storm sewer, culvert, or sanitary sewer installations.

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- B. Allowable Pipe diameters for this specification shall be between eighteen (18) inches to thirty-six (36) inches unless approved by ENGINEER and OWNER.
- C. Allowable ASTM Specifications: All material, manufacturing operations, testing, inspection, and making of HDPE pipe shall conform to the requirements of the appropriate allowable ASTM Standard Specifications, latest revision thereof, listed in

Article References.

D. Marking:

- 1. The following shall be clearly marked on both the interior and exterior surface of the pipe:
 - a. Class and size.
 - b. Date of manufacture.
 - c. Name or trademark of manufacturer.
 - d. Deflection angle for bends.

E. Diameter of Pipe: The diameter indicated on the DRAWINGS shall mean the inside diameter of the pipe.

F. Wall Thickness and Class of Pipe:

- 1. The wall thickness shall comply with the appropriate ASTM Specification and the class of pipe designated on the DRAWINGS.
- 2. HDPE pipe and fittings shall have a smooth interior and corrugated exterior. 18-inch through 36-inch pipe shall meet the requirements of AASHTO M294 Type S. The pipe shall have a full circular cross-section with annular corrugations. Pipe shall be produced to constant internal diameters.
- 3. Pipe and fittings shall be made of high-density, high-molecular weight polyethylene material meeting the requirements of cell classification 324420C or higher in accordance with ASTM D3350. Clean rework material generated by the manufacturer's own production may be used so long as the pipe or fittings produced meet all the requirements of this SPECIFICATION.

G. Fittings and Specials:

- 1. Elbows and fittings shall be mitered from pipe sections welded together on the interior and exterior at all junctions.
- 2. The pipe sections forming the miters shall be cut to fit with no gap.

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3. Tolerances on the angle of all elbows shall be plus or minus 1 degree.
4. The standard turning radius of elbows shall be 1.5 times the inside diameter. Special turning radii shall be used for special applications.
5. Elbows shall conform to the following requirements:

Angle of Elbow (Degrees)	Number of Miters
0 to 45	1
45 to 90	2

Elbows shall be designed to prevent joint rupture resulting from dynamic forces or application of a test pressure of 25 psi.

H. Joints:

1. Watertight joints shall be accomplished by rubber gasket, in accordance with ASTM D3212.
2. Gaskets shall be closed-cell synthetic, expanded rubber meeting the requirements of ASTM D1056, Grade 2A2 or made of polyisoprene meeting ASTM F477. Gaskets shall be installed on the connection by the pipe manufacturer.
3. Lubricant shall have no detrimental effect on the gasket or on the pipe.
4. Integral bell and spigot gasketed joints shall be designed so that when assembled, the elastomeric gasket, contained in a machined groove on the pipe spigot, is compressed radially in the pipe bell to form a positive seal. The joint shall be designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

3.1 GENERAL

- A. The pipe and pipe coatings shall be inspected by ENGINEER for damage or defects before being placed in the trench. Damaged or defective pipe shall not be installed.
- B. All pipes, which do not meet the requirements of PART 2 of this section, will be rejected and replaced at CONTRACTOR's expense.
- C. CONTRACTOR shall install storm sewer pipe of the type, diameter, load class, wall thickness, and protective coating that is shown on the DRAWINGS.

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- D. Proper equipment, implements, tools, and facilities shall be provided and used by CONTRACTOR for safe and convenient installation of the type of pipe being installed.

3.2 SURFACE PREPARATION

A. Within Easement, Cultivated, Landscaped, or Agricultural Area:

1. All vegetation, such as brush, sod, heavy growth of grass or weeds, decayed vegetable matter, rubbish and other unsuitable material within the area of excavation and trench side storage shall be stripped and disposed of in accordance with the requirements of Section 31 11 00, Clearing and Grubbing.
2. Topsoil shall be removed to a depth of eight (8) inches or the full depth of the topsoil, whichever is less. Topsoil shall be removed from the area to be excavated and stockpiled, or, CONTRACTOR may elect to import topsoil to replace that lost during excavation.

- B. Within Unpaved Roadway Areas: CONTRACTOR shall strip the cover material from graveled roadways or other developed, but unpaved traffic surfaces to the full depth of the existing surfacing. The surfacing shall be stockpiled to the extent that it is acceptable and useable for restoration purposes.

C. Within Paved Areas:

1. The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. Concrete pavement, asphalt, sidewalks, driveways, or curb and gutter shall be cut with a power saw to a depth of two (2) inches prior to breaking. The concrete shall be cut vertically in straight lines and avoiding acute angles.
2. Bituminous pavement, sidewalks, driveways, or curb and gutter shall be cut with a power saw, pavement breaker, or other approved method of scoring the mat prior to breaking or excavation. The bituminous mat shall be cut vertically, in straight lines and avoiding acute angles.
3. Any overbreak, separation, or other damage to the existing bituminous or concrete outside the designated cut lines shall be replaced at CONTRACTOR's expense.
4. Excavated paving materials shall be removed from the job site and shall not be used as fill or backfill.

3.3 DEWATERING

- A. All pipe trenches and excavation for structures and appurtenances shall be kept free of water during pipe laying and other related work. The method of dewatering shall provide for a dry foundation at the final grades of excavation in accordance with Section 31 23 19, Dewatering. Water shall be disposed of in a manner that does not inconvenience the

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public or result in a menace to public health. Pipe trenches shall contain enough backfill to prevent pipe flotation before dewatering is discontinued. Dewatering shall continue until such time as it is safe to allow the water to rise in the excavation.

3.4 INSTALLATION

- A. General: Precautions shall be taken to prevent foreign material from entering the pipe before or while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. The open ends of pipe shall be closed with a watertight plug, or with other devices approved by ENGINEER, at times when pipe laying is not in progress.
- B. Pipe:
 - 1. Pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used, unless otherwise shown on the DRAWINGS.
 - 2. Pipelines shall be laid to the grades and alignment shown on the DRAWINGS or staked by ENGINEER. Variation from the prescribed grade and alignment shall not exceed one-tenth (0.10) foot, and the rate of departure from, or return to, the established grade or alignment shall be not more than one (1) inch in ten (10)

feet, unless depression in the sewer invert that could retain fluids or solids. Any pipe which is not in true alignment or which shows undue settlement after laying shall be taken up and re-laid at CONTRACTOR'S expense.

- 3. Lift or roll pipe to protect coating. Do not drag over gravel or rock. Avoid striking rocks or hard objects when lowering into trench.
 - a. Pipe on which coatings have been damaged may be rejected at the site of the Work regardless of previous approvals.
- C. Pipe Fittings:
 - 1. Pipe fittings shall be laid so as to form a close concentric joint with the adjoining pipe to avoid sudden offsets of the flowline. Pipe sections shall be joined together in accordance with the manufacturer's recommendations.
 - 2. Pipe fittings and appurtenances shall be carefully lowered into the trench with suitable tools or equipment to prevent damage to the pipe and protective coatings and linings; pipe and accessory materials shall not be dropped or dumped into the trench.

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- D. Gaskets: No gaskets that show signs of deterioration, such as surface cracking or checking, shall be installed in a pipe joint. The neoprene gaskets used, when the air temperature is ten degrees Fahrenheit (10°F) or lower shall be warmed to temperature of sixty degrees Fahrenheit (60°F) for a period of thirty (30) minutes before being placed on the pipe.
- E. Obstructions not shown on the DRAWINGS may be encountered during the progress of the WORK. Should such an obstruction require an alteration to the pipe alignment or grade, ENGINEER will have authority to order a deviation from the DRAWINGS, or ENGINEER may arrange for the removal, relocation, or reconstruction of any structure which obstructs the pipeline.

3.5 BEDDING AND BACKFILL FILLING

- A. Select bedding and backfill material may be required and shall be so shown on the DRAWINGS. Select bedding materials shall conform to the designated gradation requirements in Section 31 23 33, Trenching and Backfilling.
- B. Bedding material shall be placed under and around all pipes as shown on the DRAWINGS. Bedding shall be placed in a manner that will minimize separation or change in its uniform gradation. Bedding shall be distributed in six-inch (6") maximum layers over the full width of the trench and simultaneously on both sides of the pipe. Special care shall be taken to ensure full compaction under the haunches and joints of the pipe.
- C. Backfill compaction shall not be attained by inundation or jetting, unless approved in writing by ENGINEER. Backfill material shall be uniformly compacted the full depth of the trench.

3.6 CONCRETE CUTOFF COLLARS

- A. Concrete shall meet the requirements of Section 03 31 00, Structural Concrete.

3.7 FIELD TESTING

- A. Acceptance Tests for Gravity and Low-Pressure Pipelines:

4 1. Alignment:

- a. Sewer shall be inspected by flashing a light between manholes or by physical passage where space permits.
- b. Contractor shall clean pipe of joint sealant, other dirt, and debris prior to inspection.
- c. Determine from Illumination or Physical Inspection:
 - 1) Presence of any misaligned, displaced, or broken pipe.

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2) Presence of visible infiltration or other defects.

B. Deflection Testing:

1. Maximum installed deflections of flexible pipe shall be five percent (5%) of mean internal diameter.
2. At the ENGINEER's discretion, CONTRACTOR shall test flexible pipe after backfill has been in place 30 days. Deflection is defined per ASTM D2321.
 - a. CONTRACTOR shall provide rigid ball or mandrel deflection testing equipment and labor.
 - b. Obtain approval of equipment and acceptance of method proposed for use in testing deflection of the pipe. Test shall be performed without mechanical pulling devices.
 - c. Pipe exceeding deflection limits, as defined in ASTM D2321, shall be replaced or re-compacted at CONTRACTOR's expense.

4.8 SURFACE RESTORATION

- A. All streets, alleys, driveways, sidewalks, curbs, or other surfaces broken, cut or damaged by CONTRACTOR shall be replaced in kind or as shown on the DRAWINGS.

4.9 CLEAN UP

- A. All rubbish, unused materials, and other non-native materials shall be removed from the job site. All excess excavation shall be disposed of as specified, and the right-of-way shall be left in a state of order and cleanliness.

END OF SECTION

SECTION 02810 – IRRIGATION

PART 1 – GENERAL

1.01 SCOPE

- A. An automatic underground irrigation system for exterior landscaped areas including, but not limited to, supply an installation of water meter, backflow device and controller, boring and sleeving, rotary heads and spray heads in lawn areas and spray heads and drip lines in shrub, ground cover, and flower bed areas.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Provide connection to water source (existing mainline) and new water meters as specified and in accordance with local code requirements.
 - 2. Provide for an electro-mechanical controller.
- B. Performance Requirements: Provide for irrigation at a rate of 1 in. per week applied at 2 or 3 day intervals.

1.03 QUALIFICATIONS

- A. Irrigation work to be performed by a Texas licensed irrigation company specializing in commercial irrigation installation with a minimum of five (5) years experience on similar projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.03 SCHEDULE OF VALUES

- A. Landscape/Irrigation subcontractor shall submit costs for GC schedule of values as follows:
 - 1. Irrigation Sleeving
 - 2. Irrigation Water Meter, Backflow, Permits, Testing
 - 3. Irrigation System
 - 4. Landscape Athletic Field Grading and Soil Mix
 - 5. Landscape Athletic Field Sod
 - 6. Landscape Planting, Materials, Installation, Warranty
 - 7. Landscape / Irrigation 90 Day Maintenance

1.04 SUBMITTALS

- A. Submittals shall be formatted electronically in a PDF file with a table of contents and tabs identifying each section. The following submittals are required for this section:
 - 1. Product Data: Manufacturers' technical data (Cut Sheets) and installation information for all components including: Backflow Assembly (Pressure Vacuum Breaker PVB or Reduced Pressure, Backflow Preventer RPZ (as specified), Y strainer (if required), Ball valves, PVC pipe, PVC fittings, PVC primers, solvents, cement, glue, etc., Control wire / tracking wire, Wire connectors, Pump stations, booster pumps (if specified), Pump enclosures (if specified), Controller (incl. communications modules, etc.), Rain/freeze sensors, Valves, Valve boxes, Decoders (if specified), Rotors, Sprays, Nozzles, Bubblers, Drip line, Drip filters, Drip indicators (operind), Air relief valves

1.05 QUALITY CONTROL

- A. Submit verification of water pressure at meter or point of connection.

SECTION 02810 – IRRIGATION

1.06 MAINTENANCE/WARRANTY

- A. Provide the following extra materials to the Owner:
 - 1. Two (2) quick coupler hose bib keys.
 - 2. Four (4) keys for the controller door lock.
- B. Maintenance Requirements: Maintain the work of this Section for ninety days after 'substantial completion' and until final acceptance by Owner. Notify the owner in writing of 'substantial completion'. Maintenance period begins after owner's acceptance of 'substantial completion'.
- C. Maintenance Service: Perform the following maintenance operations at least once a week:
 - 1. Test entire system and adjust timer as necessary and as directed by landscape contractor, landscape designer or owner.
 - 2. Replace or repair any broken parts or equipment.
 - 3. Report any significant problems in writing to landscape contractor, owner and landscape designer.
- D. Warranty: Warranty shall cover all parts and equipment for a period of one year from the date of final acceptance. Repairs and replacements shall be completed within two weeks of notification from owner.

PART 2- PRODUCTS

2.1 MATERIALS

- A. PVC Plastic Pipe: ASTM D 2241-83, SDR21, class 160 lateral piping; ASTM D1785, class 200 mainline piping.
- B. Pipe Fittings:
 - 1. Pipe under 3 in., id: Socket type, ASTM D 2466-78, with solvent Cement, ASTM D 2564-80.
 - 2. Pipe 3 in. id and Larger: Gasketed fittings of epoxy coated steel with non-hardening pipe dope or Teflon tape for threads.
- C. Concrete: 2500 psi min. compressive strength.

2.2 MANUFACTURED UNITS

- A. Controller: Electro-mechanical, 24 hr./14-day clock with manual operation capacity, with adequate number of stations for system operating requirements (two wire) (see irrigation equipment table). Provide both freeze-protection and rain-sensor devices with controller. Provide ground-fault interrupt and lightning protection. Provide flow control, ET Management, and IQ System. Contractor to coordinate setup and connection to IQ software including training.
- B. Water Meters: Water meters in locations shown on plans. Contractor to coordinate application, permit and installation with local utility company. Contractor responsible for water meters and all associated installation costs.
- C. Booster Pump: If required contractor shall furnish and install booster pump with enclosure as specified in plans/details. Contractor shall also provide a concrete pad and any and all

SECTION 02810 – IRRIGATION

fittings, adaptors, connections, enclosure, etc. for the complete installation and proper operation of booster pump.

- D. Backflow Preventers: Provide and install backflow devices per local codes, specifications and requirements. Provide steel mesh enclosure per plans/schedule.
- E. Electric Valves: Normally closed, 24v AC, 60 cycle, solenoid actuated, globe pattern, diaphragm type. Cast brass or plastic body and nylon reinforced nitrile rubber diaphragm.
- F. Quick coupling Valves: Cast brass body with self-closing cover. Provide (2) brass keys with 1 in. female threaded outlet.
- G. Sprinkler Heads: Heavy-duty plastic sprinkler case, high density plastic sprinkler body, corrosion-resistant internal parts, plastic spray nozzles with adjustable flow and direction features.
- H. Control Wire: 24v UL/UF., approved for direct burial. Provide color-coded wire with white used for common (14-gauge, single-strand copper) and red for control (14-gauge single-strand copper).
- I. Tracking Wire: 18 gauge copper (only where mainline and wiring bundle are separated)
- J. Valve Boxes: Heavy-duty commercial grade, fiberglass reinforced, plastic with locking covers. Rainbird/Hunter/Approved Equal VB series, 10" Round or Standard Rectangular Min. or apprvd equal.
- K. Swing Joints: 3 high density polyethylene street ells with 8 in. Schedule 80 PVC nipple; sized the same as inlet to sprinkler head.
- L. Sleeves: Schedule 40 PVC. Boring as required under all existing pavement, walls or curbs.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which irrigation work is to be performed. Irrigation contractor shall notify the landscape contractor in writing, with a copy to Construction Manager, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to irrigation contractor. Beginning of work indicates acceptance of the site as satisfactory by the irrigation contractor.

3.02 INSTALLATION

- A. General: Install tracking wire along mainline pipe if separate from valve wiring bundle.
- B. Excavating and Filling:
 - 1. Cover for Piping:
 - a) Mains: 18 in. min.
 - b) Laterals: 12 in. min.
 - 2. Use clean backfill material without stones larger than 1/2 in., debris or extraneous material that may damage pipe assembly.
 - 3. Compact all trenches to a minimum 95% Standard Proctor Density.

SECTION 02810 – IRRIGATION

- C. Pipe:
 - 1. Install in existing sleeves under pavement or provide boring and sleeves under pavement as required.
 - 2. Clean pipe and joints before making connections. Purple primer to be used on all joints before applying solvent. Per TCEQ Regulations.
 - 3. Attach joints according to manufacturer's instructions. Threaded joints to be coated with "Teflon" tape. Allow joints to set for at least 24 hrs. before applying water pressure to the system.
 - 4. Thoroughly flush piping before sprinkler heads are installed and test under pressure for leaks in each line separated by valves.
- D. Water Meters: Provide and install water meters per local codes, specifications and requirements. Coordinate permit and application with owner and local utility company. Adjust locations as necessary to coordinate with existing water line locations.
- E. Back Flow Protection: Provide and install backflow devices per local codes, specifications and requirements including enclosure.
- F. Valves:
 - 1. Provide isolation valve on inlet side of every electric control valve (if specified).
 - 2. Install electric and gate valves with at least 10 in. of cover over the valve and at least 6 in. of cover over the stem.
 - 3. Install valve box centered over the flow control handle. Provide 1 cu. ft. of clean pea gravel in the bottom of each valve box with filter fabric below.
 - 4. In lawn areas, valve boxes to be set flush with existing grade; in planting bed areas valve boxes shall be set 2" above grade.
- G. Controllers: Hard wire to nearest power source provided by GC. Coordinate connection to cellular cartridge or CAT6 data line. Install on exterior wall in location as shown on plans or as directed/approved by Owner / SSP.
- H. Sprinkler Heads: Install all heads on swing joint assemblies and flush with finish grade.
- I. Wiring:
 - 1. Bundle and tape wires at 10 ft. o.c., max.
 - 2. Snake wire in trenches to allow for expansion. Provide expansion coils at 100 ft. o.c. max., and at the entry to each valve box.
 - 3. Splice wires using mechanical sealant connector for a waterproof connection. Make all wire splices within valve boxes. Use RB WPCONN N90300 or approved equal.

3.03 FIELD QUALITY WORK

- A. General: Notify the Construction Manager at least 48 hours before testing is begun.
- B. Hydrostatic Test: Test mainline piping to a hydrostatic pressure of not less than 100 psi for a minimum of 24 hours. Piping may be tested in sections to expedite work. Remove and repair piping and connections which do not pass hydrostatic testing.
- C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.

3.04 ADJUSTING

- A. Check sprinkler heads for arc of spray. Adjust as necessary to provide 100% coverage of all landscaped areas.
- B. Adjust layout to conform to actual layout of landscape plantings.

SECTION 02810 – IRRIGATION

3.05 DEMONSTRATION

- A. Demonstrate operation of the system to Owner's personnel and staff.

3.06 CLOSE-OUT DOCUMENTS

- A. As-Built Drawings: Submit 'As-Built' drawings before project close-out showing the irrigation system layout, including line locations and sizes, spray heads and types, points of connection, booster pump, location of backflow device(s), controller, and other installation information.
- B. Warranty Letters: Submit warranty letters for all irrigation items including labor for the specified warranty period.
- C. Operation and Maintenance Data: Submit Manufacturers' operation and maintenance instructions and laminated colored (11x17) valve Zoning Diagram.

END OF SECTION

SECTION 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.
- C. Division 3 Concrete.

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).

SECTION 02831
CHAIN LINK FENCES AND GATES

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") 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. Up to 6'-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.
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.

SECTION 02831
CHAIN LINK FENCES AND GATES

- 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.

SECTION 02831
CHAIN LINK FENCES AND GATES

- 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 12" diameter by 36" minimum 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.

SECTION 02831
CHAIN LINK FENCES AND GATES

- 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, clasp 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

SECTION 02900 – PLANTING

PART 1 - GENERAL

1.01 SCOPE

- A. Supply and installation of all approved materials, labor, equipment, transportation and services required and incidental thereto, in conformity with the plans and specifications, including but not limited to; vegetation protection/pruning, fine grading, earth mounding, bed excavation and preparation, bed edging, planting soil/compost mixes, fertilizer, mulch, trees, palms, shrubs, ground covers, staking, paving, site furniture, clean-up, maintenance, and warranty.
- B. Related Sections:
 - 1. Irrigation – 02810
 - 2. Lawns – 02930

1.02 REFERENCE STANDARDS

- A. General: "Hortus Third," 1976.
- B. Texas Association of Nurserymen, Grades and Standards for Nursery Stock.
- C. Plant Material: "American Standard for Nursery Stock," ANSI Z60.1-1990.
- D. National Arborist Association Standards

1.03 DEFINITIONS

- A. Specimen Plants: Plants having exceptional character, superiority in form and branching, and the best attributes of the species; all as determined by the Architect, Landscape Designer or Owner.

1.04 QUALIFICATIONS

- A. Landscape work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.03 SCHEDULE OF VALUES

- A. Landscape subcontractor shall submit costs for GC schedule of values as follows:
 - 1. Irrigation Sleeving
 - 2. Irrigation Water Meter, Backflow, Permits, Testing
 - 3. Irrigation System
 - 4. Landscape Athletic Field Grading and Soil Mix
 - 5. Landscape Athletic Field Sod
 - 6. Landscape Planting, Materials, Installation, Warranty
 - 7. Landscape / Irrigation 90 Day Maintenance

1.04 SUBMITTALS

- A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs identifying each section. The following submittals are required for this section:
 - 1. Landscape Construction Sequence

SECTION 02900 – PLANTING

2. Edging Materials
3. Post emergent Herbicides
4. Pre emergent Herbicides
5. Soils, Compost and Mulch
6. Sources of all Plant Materials (including address and telephone numbers)
7. Product Data Material Safety Data Sheets
8. Paving Materials
9. Staking Materials
10. Samples: One foot sections of edging (as specified on plans), one pound bag sample of each; topsoil, premium compost, mulch, decomposed granite, river rock, washed gravel and example boulder/rocks.
11. Photographs of all plant material prior to ordering/installation
12. Name and License Number of Subcontractor for pruning trees (Certified I.S.A. Arborist required)

1.05 PROTECTION

- A. Before commencing work, contractor shall place orange construction fencing around all vegetation labeled "to remain" on landscape plans. Fencing shall be placed squarely around each tree 6' x 6' and at least 60" in height or continuously around groups of vegetation as shown on plans. No work may begin until this requirement is fulfilled. All other vegetation not labeled "to remain" shall be cleared and grubbed including root systems.
- B. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.
- C. The contractor shall use any and all precautionary measure when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this Contract.
- D. The Contractor shall adjust depth of earthwork and loaming when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.
- E. Where excavating, fill or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:
 - a. TRENCHING: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.
 - b. RAISING GRADES: When the existing grade at tree is below the now finished grade, and fill not exceeding 16 inches (16") is required, clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18 inches (18") and finish approximately two inches (2") above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding 16 inches (16") is required, a dry laid tree well shall be constructed around the trunk of the tree. The tree well shall extend out from the trunk on all sides a minimum of three feet (3') and to three inches (3") above finish grade. Coarse grade rock shall be placed directly around the tree well extending out the drip line of the tree. Clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly over the coarse rock to a depth of three inches (3"). Approved backfill material shall be placed directly over the washed gravel to desired finished grade.

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- c. LOWERING GRADES: Existing trees in areas where the now finished grade is to be lowered shall have grading work done by hand to elevation as indicated. Roots as required shall be cut cleanly three inches (3") below finished grade and scars covered with tree paint.
 - d. Trees marked for preservation that are located more than six inches (6") above proposed grades shall stand on broad rounded mounds and be graded smoothly into the lower level. Trees located more than 16 inches (16") above proposed grades shall have a dry laid stonewall, or other retaining structure as detailed on the plans, constructed a minimum of five feet (5') from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil.
- F. Contractor is responsible for all protection measures listed above. If these procedures are not followed, contractor is responsible for replacement of existing trees with approved trees of equal caliper and height.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Transport plant materials covered or in closed vehicles to protect from exposure to heat and wind. Spray trees and in full leaf with anti-desiccant - as recommended by the manufacturer - before shipping. Take precautions to protect plant materials from desiccation and from damage to bark, branches and roots. Do not allow root balls to crack. Schedule shipments to coincide with planting work schedule.
- B. Storage and Protection: If planting is delayed after delivery, keep plants in a shaded area, cover roots with mulch or topsoil, and keep plants constantly watered until planted.

1.07 MAINTENANCE/WARRANTY

- A. Maintenance Requirements: Maintain the work of this Section throughout construction and for ninety days after 'substantial completion' and until final written acceptance by Owner. Notify the owner in writing of 'substantial completion'. Maintenance period begins after owner's written acceptance of 'substantial completion'.
- B. Maintenance Service: Perform the following maintenance operations at least once a week:
 - 1. Remove and replace dead plant material. Prune plants to remove dead wood and to maintain health of plants.
 - 2. Maintain all mulched areas at a 2 in. depth. Remove weeds and grass from shrub and ground cover areas and from watering basins.
 - 3. Provide insect and disease control to maintain health of plants.
 - 4. Irrigation:
 - a) If the irrigation system is operating, program and monitor the system to provide adequate water for plants.
 - b) If the irrigation system is not operating, hand water plants. Deep water trees each week.
 - 5. Dispose of all maintenance debris/clippings off-site. Owner's dumpsters shall not be used.
 - 6. Keep all site areas tidy and free of grass clippings, mulch or other foreign materials.
 - 7. Submit dates, descriptions and receipts of all maintenance operations to SSP Design for approval.
- C. Warranty: Warranty shall cover all shrubs/groundcovers for a period of three months and trees/palms for a period of one year from the date of final acceptance. Any plant material deemed dead or unrecoverable by the owner shall be replaced with similar species and size within two weeks of notification from owner.

1.08 RIGHT OF REJECTION

SECTION 02900 – PLANTING

- A. The Owner/SSP Design reserve the right to inspect and reject plants at any time and at any place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fertilizer: 13-13-13 Osmocote slow release fertilizer granules or approved equal.
- B. Planting tablets: Agraform 21 gram slow release fertilizer tablets or approved equal.
- C. Compost: Premium grade compost ('9 Kids Compost' or approved equal).
- D. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/GC in soil.
- E. Sand: Clean, screened inorganic masonry sand. Silica sand only. River sand not acceptable. Mathis sand, Wright Materials, Plant 3 masonry sand (361) 387-0293 or approved equal
- F. Mulch:
 - 1. Shrub and Ground Cover Planting Areas: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.
 - 2. Watering basins: Grade A Shredded Hardwood; long, fibrous bark strands free from wood chips. Texas Natives or Approved Equal.
- G. Plants:
 - 1. General: Provide plant materials that are healthy and free from disease, insects, and larvae and without damage to bark, branches, and roots.
 - 2. Approval: All plants must be approved by Owner/SSP Design prior to installation. Any plants not approved by Owner/SSP Design shall be subject to rejection. All trees/palms must be inspected, approved and tagged by Owner/SSP Design at their place of origin or as directed in writing by Owner/SSP Design. Container grown trees shall be obtained by Glen Flora Farms, Inc. or approved equal.
 - 3. Sizes: Measured after pruning and in accordance with the plant schedule.
 - 4. Root Treatment: As follows in accordance with the Reference Standards:
 - a) Palms: Balled and burlapped or containerized if they have been in the container for at least one growing season.
 - b) Trees, Shrubs, Ground Cover Plants: Container grown with a well-established fibrous root system.
 - 5. Palms: All new palms shall be field dug or containerized material in specified sizes shown in plant schedule. All palms shall have good form (straight trunks) consistent of its species, free of scares/abrasions/burn marks and disease and insects, with large healthy root systems. Rootballs sizes for B/B material must meet the following minimum specifications:
 - a) Sabal Palms - 44" diameter, 36" height
 - b) Washingtonia Palms - 44" diameter, 36" height
 - c) Cuban Royal Palms, Mediterranean Fan Palms, Cocos Palms - 30" diameter, 30" height
- H. Staking material:

SECTION 02900 – PLANTING

1. Tree stakes shall be commercial grade T-Posts, 1.25 Gauge, 8' Ht., Green with orange safety caps on tops. Note: Do not drive through stakes through root balls.
2. Tree ties shall be Poly Chain Lock – 1" width, black, ProLock or approved equal
3. Palm stakes shall be treated timber braces, stakes, and battens including burlap protection and steel straps sized per palm planting detail. Ground stakes must be at least 48" in length with at least 42" securely embedded in undisturbed soil.

I. Edging:

1. Concrete Edging: Extruded, colored, fibermesh reinforced concrete edging (per details) *Contour Curbs (or approved equal)*
2. Tree Rings: 4" Ht., 30" Dia., Black Anodized Aluminum tree rings. *Dreamscapes (or approved equal)*
3. Aluminum edging: 4" Ht., Black Anodized Aluminum Edging. *Dreamscapes (or approved equal)*

2.2 PLANTING SOILS

- A. Planting Mix: 75 percent sandy-loam topsoil; 25 percent premium compost; (3:1 ratio by volume); and specified fertilizer or planting tablets.
- B. Shrub and Ground Cover Areas:
 1. Where no topsoil has been installed: Remove twelve inches of existing soil and replace with ten inches of 'Planting Mix' as described in Item A above.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which landscape work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP Design if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 EXECUTION

- A. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by Owner/SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by Owner/SSP Design.
- B. Drainage: Landscape contractor shall follow grading as shown and specified on Civil Engineer's grading plans. Landscape contractor shall coordinate grading operations with site contractor. Landscape contractor shall ensure final grades conform to the Civil Engineer's grading plan including grades around building, swales, sidewalk under-drains/swales, roof drains, splash blocks and rock swales through planting beds.
- C. Vegetation Protection: Contractors are responsible for protection of existing vegetation labeled on plans "to remain". Protection of existing vegetation includes supply and installation of protective fencing around all existing planting areas.

SECTION 02900 – PLANTING

- D. Bed Preparation and herbicide: All planting areas shall be free of weeds, grass, insects, or any other deleterious material prior to bed preparation. Contractor shall herbicide all planting areas with 'RoundUp' or approved equal at least two times prior to installation of any new plants. Pre-emergent herbicide shall be applied after planting and before placement of mulch.
- E. Planting Beds: Excavate 12" of existing soil within planting beds and replace with 8" of imported topsoil and 2" of premium compost. Mechanically till into top six inches of bed until a loose, friable soil condition is met. Final grades within all planting beds shall be 2-3" below adjacent curbs to allow for mulch. Contractor to ensure positive drainage throughout all landscape areas. Adjust grades as necessary to direct water away from planting beds. Report any discrepancies on all drainage issues in writing to Construction Manager or the Civil Engineer. Owner or SSP Design to approve planting beds prior to planting operations.
- F. Edging: Edging shall be installed as shown on plans. Edging shall allow for tapered drainage points to ensure free drainage away from all structures and walkways. Edging shall be set flush with adjacent paving, sidewalks or driveways.
- G. Grass Areas: Scarify, float and fine grade all areas to receive sod or hydromulch for approval by SSP prior to placement of sod or application of hydromulch. Supply additional topsoil as necessary to fill any/all low areas and ensure positive drainage away building / planting beds. (see specification on lawns for further requirements).
- H. Berms and Mounding: Supply topsoil and construct berms as indicated on plans. Berms shall have a maximum slope of 1:4. Owner or Construction manager to approve berming and mounding prior to planting operations.
- I. Planting:
 - 1. Installation:
 - a) Excavate planting pit and french drains to depth and width indicated on details in drawings.
 - b) Set root ball on undisturbed or compacted soil in planting pit. Remove burlap, rope, wire, and all other wrapping material from top of ball. Remove any binding rope which is not biodegradable completely. Top of root ball shall be set 1" above adjacent finished grade.
 - c) Fill planting pit 2/3 full with planting mix, soak with water and allow settling, and adding fertilizer tablets as detailed. Finish filling pit with planting mix and tamp lightly.
 - d) Construct a watering basin as detailed (or install aluminum edge tree ring) and install 2 in. layer of mulch. Water-in to completely saturate the root ball and planting mix. Add planting mix where any settling or air pockets occur.
 - e) Stake all trees/palms immediately after planting as detailed.
 - 2. Palms: New Washingtonia palms shall be cleaned (skinned) completely of their leafstem bases and fibers to a height 4 feet below the crown. Sabal palms shall be planted with their leafstem bases remaining but cleaned and trimmed evenly. All palms shall be planted with several petioles or fronds tied up straight with natural twine. Remaining fronds shall be trimmed or 'hurricane cut' to lighten wind load on terminal bud. Contractor is responsible for removing or cutting the twine supporting the fronds at the appropriate time. All palms must be inspected and approved on site by SSP Design prior to installation.

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3. Shrubs: All plants shall be of species denoted on plans and shall be container-grown material at specified sizes. All plants shall be of size equal or greater than T.A.N. standards for their respective container size. All material shall be vigorous, well established, of good form consistent of species, free of disease and insects, with large healthy root systems and with no evidence of being restricted or damaged. All plants shall be inspected and approved on site by SSP Design prior to installation.
4. Planting Holes: All tree/palm holes shall be excavated with a diameter at least two times the rootball size and to a depth equal to the height of the rootball. The bottoms and sides of each hole shall be scarified with a pick to allow for free drainage and maximum root penetration. After tree/palm placement, the hole shall be backfilled with a mixture of excavated soil and premium compost mixture (9 Kids Compost or approved equal). All holes shall be tested/inspected by SSP Design for free drainage prior to installation of trees.
5. Tree Rings: Tree rings shall be installed on trees within grass areas as indicated on plans. Tree rings are to be aluminum edge or extruded concrete per plans and details. A minimum of 2 inches of specified mulch shall be placed within the tree rings. Tree rings must be maintained and kept free of weeds during the entire maintenance period.
6. Watering Basins: Watering basins for all trees/palms that do not include an aluminum edge tree ring shall be constructed in a ring shape around each tree or palm trunk. This earthen berm shall be constructed 6" in height and 36" in diameter so as to hold water and allow infiltration around root ball. A minimum of 2 inches of specified mulch shall be placed within the watering basin. Watering basins must be maintained and kept free of weeds during the entire maintenance period.
- J. Insect and Disease Control: Apply treatment as frequently as required during construction and 90-day maintenance period to prevent damage to plant material. Use only chemicals specifically approved by TNRCC.
- K. Pruning: All existing and new vegetation shall be pruned/trimmed by a Certified I.S.A. Arborist as directed on site by SSP Design.

3.03 CLEANUP AND PROTECTION

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.
- B. Provide temporary barriers or fences as required to protect landscaping from any type of damage or theft until final acceptance.

3.04 CLOSE-OUT DOCUMENTS

- A. As-Built Drawings: Submit 'As-Built' drawings before project close-out showing the landscape layout, including revised plant material, and other installation information.
- B. Warranty Letters: Submit warranty letters for trees / palms / lawns / shrubs / pavers / furniture / masonry / stone / amenities.

END OF SECTION

SECTION 02930 – LAWNS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: The establishment of a complete and uniform lawn by sodding and/or hydromulching.
- B. Related Sections:
 - 1. Section 02810-Irrigation
 - 2. Section 02900-Planting

1.02 QUALIFICATIONS

- A. Lawn work to be performed by a single firm specializing in commercial landscape work with a minimum of five (5) years experience on similar type projects. Owner/SSP Design to review qualifications and approve subcontractor prior to commencing work.

1.03 SCHEDULE OF VALUES

- A. Landscape subcontractor shall submit costs for GC schedule of values as follows:
 - 1. Irrigation Sleeving
 - 2. Irrigation Water Meter, Backflow, Permits, Testing
 - 3. Irrigation System
 - 4. Landscape Athletic Field Grading and Soil Mix
 - 5. Landscape Athletic Field Sod
 - 6. Landscape Planting, Materials, Installation, Warranty
 - 7. Landscape / Irrigation 90 Day Maintenance

1.03 SUBMITTALS

- A. Submittals shall be formatted electronically in a pdf file with a table of contents and tabs identifying each section. The following submittals are required for this section:
 - 1. Product Data: Manufacturer's specifications and application instructions for fertilizer.
 - 2. Hydromulch mixes, percentages, lbs per acre, etc. for SSP review and approval before application.
 - 3. Samples: Topsoil, compost, silica/masonry sand for SSP review and approval before installation.
 - 4. Certificates: Inspection certificate from Texas Department of Agriculture indicating sod has been found free of diseases, insects and larvae.
 - 5. Certificates: Breakdown of seed types, percentages, and mixture composition.
 - 6. Sod Delivery Tickets: One per truckload indicating sod species, nursery certification, date and time of cutting.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Sod Delivery: Have sod delivered within forty-eight hours of cutting. Stack sod with roots to roots, protected from exposure to elements during shipment.
- B. Storage: Lay sod as soon as practicable after delivery. If installation is delayed more than four hours, store sod under shade and keep constantly moist. Sod must be laid within forty-eight hours of cutting. Do not pile more than two foot depth of sod. Do not tear, stretch or drop sod. Do not allow soil to break free of turf roots.

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1.05 PROJECT CONDITIONS

- A. Utility Construction: Do not lay sod or begin hydro-mulching until all underlying utility work is complete, trenches backfilled, compacted and graded, and topsoil placed and fine graded and sports fields laser leveled and approved by Owner/SSP.

1.06 MAINTENANCE/WARRANTY

- A. Maintenance Service: Maintain the work of this Section throughout construction until the Date of Substantial Completion and ninety (90) days thereafter until a complete and uniform lawn has been established and accepted by the Owner / SSP.
1. Establish hydro-mulched or sodded lawns per planting plans. Reapply hydro-mulch or re-sod as necessary until **full and uniform** coverage is obtained.
 2. Mow general lawn areas **at least once per week** to maintain height of grass at 2 inches or as directed by Owner/SSP. Mowing of general lawn areas may be carried out using standard rotary type mowing equipment.
 3. Mow Sports Fields **at least twice per week** to maintain an initial height of 2" for the establishment period then begin lowering the height over the next 90-days to achieve a final height of one inch. Mowing of Sports Field areas shall be carried out using reel type mowers only. Rotary mowers will not be accepted for Sports Field maintenance.
 4. Trim/edge all lawn areas adjacent to watering basins, pavements, driveways, walls, structures, curbs, planting beds, edges and islands.
 5. Provide insect and disease control to maintain health of grass.
 6. Apply pre and post emergent herbicides as required or directed to control weed growth throughout the establishment and maintenance periods.
 7. Fertilize general lawn areas (minimum two applications) with balanced commercial grade lawn fertilizer until complete and uniform coverage is obtained.
 8. Fertilize Sports Field areas (minimum four applications) using a high nitrogen formula such as HJ 25-0-0 with Wolftrax or Scotts Sierrablen 27+5+5+Fe or Scotts Fairwaymaster 20+5+8 or approved equal.

Note: Submit fertilizer type for SSP review and approval prior to application. Depending on time of year, SSP may require a fertilizer that includes pre or post emergent herbicide.

9. Verti-cut or de-thatch Sports Field turf at least one time during the maintenance period.
10. Apply top dressing (clean inorganic sand) to level any divots, depressions or low spots during the maintenance period. Application of top dressing sand shall be accomplished utilizing a mechanical top dresser (Lely or approved equal).
11. Irrigation:
 - a) If the irrigation system is operating, program and monitor the system to provide adequate water for grass.
 - b) If the irrigation system is not operating, hand water grass.
12. Submit receipts/dates of all maintenance operations to SSP Design for approval.

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- B. Warranty: Warranty shall cover all lawn grasses for a period of three months from the date of final acceptance. Final acceptance will not be approved until full and uniform lawns are completely established and proof of all fertilizations including receipts have been reviewed and accepted.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5%, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.
- B. Sand: For athletic/sports fields. Silica sand, clean, screened and free of debris. (Mathis Sand, Wright Materials Plant-3, Tel. (361) 387-0293 or approved equal).
- C. Sod: (See schedule for type). Provide premium #1 certified sod grown in a sod nursery on sandy soil, at least 1 yr. old with a heavy top and a strong, well-knit root system, and not more than five percent weeds or foreign grasses.
- D. Hydromulch Material. Material for hydraulic mulching shall consist of virgin wood fibers manufactured expressly from clean whole wood chips. The chips shall be processed in such a manner as to contain no growth or germination inhibiting factors. Fiber shall not be produced from recycled materials such as sawdust, paper, cardboard, or residue from pulp and pure plants. The wood cellulose fiber mulch shall be dyed green to aid in visual metering during application. The dye shall be biodegradable and not inhibit plant growth. The wood cellulose fibers of the mulch must maintain uniform suspension in water under agitation. Upon application, the moist material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption, percolation, and shall cover and hold seed in contact with the soil. The Contractor shall obtain certifications from suppliers that laboratory, field-testing of their product has been accomplished, and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch. Terra-Mulch Terra-Blend with UltraGro or approved equal.
- E. Fertilizer: Starter fertilizer (BCF 15-15-15) shall be used in hydro-mulch mix. The Contractor shall provide a Soil Analysis Report and shall use report to determine quantity and ratio of fertilizer for sustained growth of grass.

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- F. Soil and Mulch Tackifier: Tackifier used with mulch shall be organic. Tackifier shall be mixed and applied with the hydromulch at an appropriate rate to stabilize soils and minimize erosion. Tackifier shall be pH stable with fertilizer and shall hydrate and disperse in mixing tank with water and other materials to form homogeneous slurry. Tackifier shall leave loose, chain-like stabilizing film on surface of soil, allow moisture to percolate into soil during seed germination and seedling growth, and break itself down through microbial action. Tackifier shall not inhibit plant germination or growth.
1. Organic Tackifier. Organic tackifier shall be, starch-based tackifier formulated for use with conventional mulches. Active ingredient in tackifier shall be 100 percent derived from plant starch.
 2. Dry powder tackifier shall be blended with insolubilizer. After blending and mixing with water, tackifier shall swell, become sticky, and be suitable for use during heavy rain. Tackifier shall be applied at rate of 80 pounds per acre. Emulsion shall cure on surface of soil and become insoluble. Tackifier shall not inhibit plant germination or growth.
- G. Fertilizer: 12-4-8 (N-P-K), formulated for slow-release Nitrogen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine the site and conditions under which this work is to be performed. Have the installer notify the Contractor in writing, with a copy to SSP Design, if the site is unsatisfactory. Do not begin the work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Beginning of work indicates acceptance of the site as satisfactory by the installer.

3.02 PREPARATION

- A. Topsoil: Refer to Section 02900 'Landscaping' for topsoil amendment.
- B. Site Preparation: Contractors must visit and review site prior to bidding. Compacted soils and sub-soils from construction activities must be ripped and tilled until a loose, friable and free-draining condition is met. All existing weeds, grass, stabilized sub-base material, rubble, excavated soil and other material shall be removed from the site and disposed of by the contractor prior to starting any new landscape work. Soil conditions around entire site must be approved by SSP Design prior to rough and finished grading operations. Contractor shall not install any fill or topsoil in landscape areas prior to site condition approval by SSP Design.

3.03 INSTALLATION – HYDROMULCH / SOD

- A. All exterior ground within the limit of contract or any damaged adjacent areas, except surfaces occupied by structures and paving, except areas indicated to be undisturbed, shall be seeded, hydromulched, sodded or planted as shown on drawings. Furnish topsoil (if required or specified in plans/schedules), provide finish grading, prepare seed bed, seed, hydromulch, sod and maintain areas as indicated on the drawings.
- B. Lawn Area Preparations - Grade areas to finish grades, filling as needed or removing surplus material. Float all lawn areas to a smooth, uniform grade as indicated on engineers grading plans. All lawn areas shall slope to drain away from structures and

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planting beds. Where no grades are shown, areas shall have a smooth and continual grade between existing or fixed controls (such as walks, curbs, catch basin, elevational steps or structures) and elevations shown on plans. Contractor to ensure proper drainage around all structures. Adjust grades as necessary to direct water away from structures and planting beds. Report any discrepancies on all drainage issues in writing to SSP Design or the project engineer.

- C. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces. All finish grades shall meet approval of the SSP, before seeding/hydromulching operations. Loosen soil to a depth of six inches (3") in lawn areas by approved method of scarification and grade to remove edges and depressions. Remove stones or foreign matter over one half inch (1/2") in diameter from the top two inches (2") of soil. Float lawn areas to finish grades as shown on civil plans. Install topsoil over prepared subbase if included in materials schedules or as required to allow for a proper seed bed for germination and strong healthy growth of sod.
- D. Lawn areas should be permitted to settle or should be firmed by rolling before hydromulching or sodding.
- E. Hydromulching shall not be performed in windy weather.
- F. Lawn areas shall be seeded by hydro-mulching evenly with an approved mechanical hydro-mulcher at the rate of a minimum of three (5) pounds per 1,000 square feet. In areas inaccessible to hydro-mulching equipment, the seeded ground shall be lightly raked with flexible rakes and rolled with a water ballast roller. After rolling, seeded areas are to be lightly mulched with wheat straw or approved material.
- G. Lawns shall be maintained by the Contractor for at least 90 days after substantial completion or as long as necessary to establish a uniform stand of the specified grasses, or until final acceptance of lawns, whichever is later.
- H. Water hydromulched / sodded areas to a minimum depth of six inches (6") with a fine spray as necessary to the equivalent of one inch (1") per week. Increase or decrease watering based on season and weather / rainfall amounts.
- I. The surface layer of soil for hydromulched areas must be kept moist during the germination period. Set irrigation controller to short (5 minute) cycles, multiple times per day to keep hydromulch moist but prevent runoff and erosion. Any eroded areas of hydromulch must be regraded and re-hydromulched.
- J. Sod shall be installed to all areas as indicated on plans.
- K. Sod Bed Preparation – See A, B, C, D above All lawn areas are to slope to drain.
- L. Sod shall be laid within 48hrs of being cut or 24 hours after delivery to the project site. Only healthy vigorous growing sod is to be laid. Any stressed or yellowing sod shall be rejected.
- M. Always lay sod across slope and tightly together so as to make a solid area. All rolls or pieces of sod must be butt-jointed with no open joints. Any open joints will require clean sand or topsoil fill and re-leveling and rolling.
- N. Roll all new sod sufficiently to set or press sod into underlying soil and provide a smooth and even finished surface. Mechanical 2 ton roller or equivalent is required.

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- O. After sodding has been completed, clean up and thoroughly moisten by sprinkler newly sodded areas.
- P. Make weekly inspections to determine the moisture content of the soil and adjust the watering schedule established by the irrigation system installer to fit conditions
- Q. After grass growth has started, all areas or parts of areas, which fail to show a uniform stand of grass for any reason whatsoever shall be re-hydromulched or sodded in accordance with the plans and as specified herein. Such areas and parts of areas shall be hydromulched or sodded repeatedly until all areas are covered with a full and uniform stand of grass at no additional cost to the Owner.
- R. Watering shall be done in such a manner and as frequently as is deemed necessary by SSP to assure continued growth of healthy grass. All areas of the site shall be watered in such a way as to prevent erosion due to excessive quantities applied over small areas and to avoid damage to the finished surface due to the watering equipment.
- S. Water for the execution and maintenance of this work shall be provided by the Owner at no expense to the Contractor. The Contractor shall, however, furnish his own portable tanks, pumps, hose, pipe, connections, nozzles, and any other equipment required to transport the water from the available outlets and apply it to the seeded area in an approved manner.
- T. Mowing of the seeded, hydromulched or sodded areas shall be initiated when the grass has attained a height of one and one-half to two inches (1-1/2" to 2"). Grass height shall be maintained between one and one and one-half inches (1 to 1½") at subsequent cutting depending on the time of year. Not more than one third (1/3) of the grass leaf shall be removed at any cutting and cutting shall not occur more than seven (7) days apart.
- U. When the amount of grass is heavy, it shall be removed to prevent destruction of the underlying turf. If weeds or other undesirable vegetation threaten to smother or takeover the planted species, such vegetation shall be mowed or, in the case of rank growths, shall be uprooted, raked and removed from the area by methods approved by the SSP.
- V. Protect hydromulched / sodded areas against trespassing while the grass is germinating and/or growing in. Furnish and install fences, signs, barriers or any other necessary temporary protective devices. Damage resulting from trespass, erosion, washout, settlement or other causes shall be repaired by the Contractor at his expense.
- W. Remove all fences, signs, barriers or other temporary protective devices after final acceptable.

3.04 FERTILIZING – GRASS

Fertilizer shall be included in the hydromulch mixture. After full germination and or sodding, all lawn areas shall have fertilizer applied in two (2) applications with a thorough watering immediately following application. The first application shall be one (1) week after sodding or full germination at the rate of 5 pounds per 1,000 square feet. The second application shall be done after 60 days at the rate of 3 pounds per 1,000 square feet. Soil analysis and time of year shall be considered with SSP to determine fertilizer type, composition and final application rates. Submit fertilizer type and analysis to SSP for approval before any application. Document fertilizer application with photos and receipts of fertilizer purchases.

SECTION 02930 – LAWNS

3.05 CLEANUP AND PROTECTION

- A. Remove debris from landscaped areas daily and sweep clean adjacent pavements, if soiled by landscape activities.
- B. Protect lawns from damage, theft or vandalism until final acceptance. Install stakes and flagging or temporary fencing if required to keep traffic off newly established lawn areas

END OF SECTION

SECTION 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".

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.

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- 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

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork for cast-in place concrete.
 - 2. Shoring, bracing, and anchorage.
 - 3. Architectural form liners.
 - 4. Form accessories.
 - 5. Form stripping.
- B. Related Sections:
 - 1. Section 032000 - Concrete Reinforcement.
 - 2. Section 033000 - Cast-in-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 347 - Guide to Formwork for Concrete.
- B. American Forest and Paper Association:
 - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- E. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

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1.3 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum .03 perms when tested in accordance with ASTM E96, Procedure A.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 347 ACI 301 ACI 318.
- B. For wood products furnished for work of this Section, comply with AF&PA.
- C. Perform Work in accordance with State Municipality of Highways Public Work's standard.

1.6 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

2.2 FORMWORK ACCESSORIES

- A. Vapor Retarder: Where indicated on Drawings, 10 mil thick polyethylene sheet manufacture by:
 - 1. Stego Wrap Class A: by Stego Industries LLC (887) 464-7834
 - 2. Griffolyn by Reef Industries (800) 231-6074
 - 3. VaporBlock 10 by Raven Industries (800) 635-3456
 - 4. Perminator Vapor – May by W.R. Meadows (800) 342-5976
 - 5. Xtreme by Tex-Trude (281) 452-5961
 - 6. Or Equivalent

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- B. Bituminous Joint Filler: ASTM D1751.
- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- D. Water Stops: Rubber Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, inch wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

***** OR *****

- E. Waterstop: Flexible strip of bentonite waterproofing compound in coil form for joints in concrete construction.
 - 1. Colloid Environmental Technologies Company Model.
 - 2. TC MiraDRi Model.
 - 3. Paramount Technical Products Model.
 - 4. Substitutions: Section 016000 - Product Requirements Not Permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Earth forms are not permitted.
- B. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 - 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.

5. Complete wedging and bracing before placing concrete.
- C. Forms for Smooth Finish Concrete:
 1. Use steel, plywood or lined board forms.
 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 4. Use full size sheets of form lines and plywood wherever possible.
 5. Tape joints to prevent protrusions in concrete.
 6. Use care in forming and stripping wood forms to protect corners and edges.
 7. Level and continue horizontal joints.
 8. Keep wood forms wet until stripped.
- D. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301 ACI 318.
- E. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- F. Obtain Architect/Engineer's approval before framing openings in structural members not indicated on Drawings.
- G. Install fillet and chamfer strips on external corners of beams joists columns and.
- H. Install void forms in accordance with manufacturer's recommendations.
 1. SureVoid Products, Inc., Englewood, CO (800) 458-5444.
- I. Do not reuse wood formwork more than times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Install formed openings for items to be embedded in or passing through concrete work.
- B. Locate and set in place items required to be cast directly into concrete.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- G. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1 inch away from finished surface of concrete.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
- H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- I. Construction Joints:
 - 1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 - 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 - 4. Arrange joints in continuous line straight, true and sharp.
- J. Openings for Items Passing Through Concrete:
 - 1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
 - 2. Coordinate work to avoid cutting and patching of concrete after placement.
 - 3. Perform cutting and repairing of concrete required as result of failure to provide required openings.
- K. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 2. Slope slabs to drain where required or as shown on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- L. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
 2. Staking through membrane is not be permitted.
- M. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
 2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Architect/Engineer.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301 ACI 318.

***** OR *****

- B. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301 ACI 318.

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3.8 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements 017000 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.
- D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 31 05 13

SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.
- B. Related Sections:
 - 1. Section 310513 - Aggregates for Earthwork.
 - 2. Section 320516 - Aggregates for Exterior Improvements.
 - 3. Section 312213 - Rough Grading.
 - 4. Section 312323 - Backfill.
 - 5. Section 312317 - Trenching.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and Inspection Services Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.

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- D. When tests indicate materials do not meet specified requirements, change material and retest.
- E. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials subsoil and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations designated by Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing designated trees, shrubs, and other plant life.
 - 3. Removing abandoned utilities.
 - 4. Excavating topsoil.
- B. Related Sections:
 - 1. Section 312213 - Rough Grading.
 - 2. Section 312318 - Rock Removal.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify waste area for placing removed materials.

2.2 PREPARATION

- A. Call Local Utility Line Information not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

2.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

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2.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within marked areas. Remove stumps.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

2.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- D. Do not burn or bury materials on site. Leave site in clean condition.

2.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating topsoil.
 - 2. Excavating subsoil.
 - 3. Cutting, grading, filling, compacting site for site structures, building pads.
- B. Related Sections:
 - 1. Section 310513 - Soils for Earthwork: Soils for fill.
 - 2. Section 310516 - Aggregates for Earthwork: Aggregates for fill.
 - 3. Section 311000 - Site Clearing: Excavating topsoil.
 - 4. Section 312316 - Excavation and Fill: Building excavation.
 - 5. Section 312318 - Rock Removal.
 - 6. Section 312323 - Backfill: General building area backfilling.
 - 7. Section 312317 - Trenching: Trenching and backfilling for utilities.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
 - 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

PART 2 EXECUTION

2.1 PREPARATION

- A. Call Local Utility Line Information service not less than three working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Protect utilities indicated to remain from damage.
- D. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

2.2 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place fill material in continuous layers and compact as required.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.

2.3 FIELD QUALITY CONTROL

- A. Perform in place compaction tests in accordance with the following:
 1. As required by geotechnical engineer.

END OF SECTION

SECTION 31 23 16
EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil densification.
 - 2. Excavating for building foundations.
 - 3. Excavating for slabs-on-grade.
 - 4. Excavating for site structures.
- B. Related Sections:
 - 1. Section 310513 - Soils for Earthwork: Stockpiling excavated materials.
 - 2. Section 310516 - Aggregates for Earthwork: Stockpiling excavated materials.
 - 3. Section 312213 - Rough Grading: Topsoil and subsoil removal from site surface.
 - 4. Section 312318- Rock Removal: Removal of rock during excavating.
 - 5. Section 312323- Backfill.
 - 6. Section 312317 - Trenching: Excavating for utility trenches.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- B. Local utility standards when working within 24 inches of utility lines.

PART 2 EXECUTION

2.1 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate building foundations, slabs-on-grade.
- C. Excavate to working elevation for piling work.

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- D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and Section 02324.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Notify Architect/Engineer of unexpected subsurface conditions.
- H. Correct areas over excavated with structural fill.
- I. Remove excess and unsuitable material from site.
- J. Repair or replace items indicated to remain damaged by excavation.

2.2 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil treatment for termite control.
- B. Related Sections:
 - 1. Section 310513 - Soils for Earthwork: Backfill materials.
 - 2. Section 312316 - Excavation and Fill: Subgrade preparation.
 - 3. Section 033000 - Cast-In-Place Concrete: Slabs on grade and foundations placed over treated soil.

1.2 REFERENCES

- A. Environmental Protection Agency:
 - 1. EPA FIFRA - Federal Insecticide, Fungicide and Rodenticide Act.
- B. National Pest Management Association:
 - 1. NPMA WDO - Wood Destroying Organism Library.

1.3 SUBMITTALS

- A. Product Data: Submit toxicants to be used, composition by percentage, dilution schedule, intended application rate. Include product label information.
- B. Test Reports: Indicate regulatory agency approval reports.
- C. Manufacturer's Application Instructions: Indicate caution requirements and in accordance with current product label of chosen pesticide.
- D. Certify applications followed NPMA WDO for termite control or other regional location guidance.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record moisture content of soil before application, date and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage.
- B. Operation and Maintenance Data: Indicate re-treatment schedule.

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1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing the Work of this section and licensed in State of Texas.

1.6 SEQUENCING

- A. Section 011000 - Summary: Work sequence.
- B. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade in accordance with product label supplemented by the NPCA's ARP for termiticiding or local requirements.

1.7 WARRANTY

- A. Warranty: Include coverage for damage and repairs to building and building contents caused by termites. Repair damage. Re-treat where required.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Toxicant Chemical: EPA FIFRA approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

2.2 MIXES

- A. Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- C. Verify final grading and excavation are complete.

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3.2 APPLICATION

- A. Apply toxicant at locations indicated in Schedule at end of section.
- B. Apply extra treatment to structure penetration surfaces including pipe or ducts, and soil penetrations including grounding rods or posts.
- C. Re-treat disturbed treated soil with same toxicant as original treatment.
- D. When inspection or testing identifies presence of termites, re-treat soil and re-test.

3.3 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit soil grading over treated work.

3.4 SCHEDULES

- A. Locations:
 - 1. Under Slabs-on-Grade.
 - 2. Both Sides of Foundation Surface.

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.
- E. Water: Drinkable.

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- 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.
 - "Pozzolith 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.
 - 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:

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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, products that may be incorporated in the work include, but are not limited to, the following:
 - "Spartan-Cote," The Burke Co.
 - "Hardtop," Cormix.
 - "Eucocure," Euclid Chemical Co.
 - "Masterkure," Master Builders, Inc.
 - "CS-309,fl W.R. Meadows, Inc.
 - "LR-151," Prokrete Industries.
 - "Kure-N-Seal," Sonneborn-Rexnord.
 - "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

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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.

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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.

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.

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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.

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.

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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,

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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.

- 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.

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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.

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.

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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 fiver-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.

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

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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 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

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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 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finishing concrete floors [and floor toppings].
 - 2. Floor surface treatment.
- B. Related Sections:
 - 1. Section 033000 - Cast-in-Place Concrete: [Prepared concrete floors ready to receive finish;] [control and formed expansion and contraction joints and joint devices].
 - 2. Section 03360 - Concrete Finishes: Exposed aggregate finish.
 - 3. Section 033900 - Concrete Curing.
 - 4. Section 079513 - Expansion Joint Cover Assemblies.
 - 5. Section 079200 - Joint Sealers.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
- B. ASTM International:
 - 1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on concrete hardener, sealer, curing compounds curing papers and slip resistant treatment, compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

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1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

1.8 COMPOUNDS - HARDENERS AND SEALERS

- A. Chemical Hardener: Magnesium fluorosilicate and zinc fluorosilicate blend

PART 2 EXECUTION

2.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify floor surfaces are acceptable to receive the Work of this section.

2.2 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. Wood float surfaces receiving quarry tile, ceramic tile, and cementitious terrazzo with full bed setting system.
- C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile, and thin set ceramic tile.
- D. Steel trowel surfaces which are scheduled to be exposed.

2.3 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E1155, within 48 hours after slab installation.
- C. Finish concrete to achieve the following tolerances:

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1. Under Glazed Tile on Setting Bed: F(F) 35 and F(L) 20.
 2. Under Resilient Finishes: F(F) 75 and F(L) 50.
 3. Exposed to View and Foot Traffic: F(F) 75 and F(L) 40.
 4. Correct slab surface when actual F(F) or F(L) number for floor installation measures less than required.
- D. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION

SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Sections:
 - 1. Section 033000 - Cast-In-Place Concrete.
 - 2. Section 033500 - Concrete Finishing.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
 - 3. ACI 308.1 - Standard Specification for Curing Concrete.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. ASTM International:
 - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Membrane Curing Compound Type 1.
- B. Membrane Curing Compound: ASTM C1315 Type I.
- C. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

- A. Cure concrete in accordance with ACI 308.1.
- B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.

***** [OR] *****

- C. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

***** [OR] *****

- D. Absorptive Mat: Spread cotton fabric over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days.

***** [OR] *****

- E. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.

3.3 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.

3.4 SCHEDULES

- A. Storage Area Slabs: Absorptive mats, burlap-polyethylene type.
- B. Retaining Walls: Membrane curing compound, acrylic type, clear color.
- C. Concrete Pavement: Membrane curing compound, opaque color.
- D. Other Floor Areas: Membrane curing compound, acrylic type, translucent color.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement grout.
 - 2. Rapid curing epoxy grout.
 - 3. Non-shrink cementitious grout.
- B. Related Sections:
 - 1. Section 033000 - Cast-in-Place Concrete.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society of Testing and Materials:
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
 - 5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
 - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing and Polymer Concretes.
 - 8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
 - 1. CRD C621 - Non-Shrink Grout.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

- A. Portland Cement: ASTM C150, Type I and II.
- B. Water:
1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.
- C. Fine Aggregate:
1. Washed natural sand.
 2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
 3. Free from injurious amounts of organic impurities as determined by ASTM C40.
- D. Mix:
1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID CURING EPOXY GROUT

- A. Rapid Curing Epoxy Grout: High strength, three component epoxy grout formulated with thermosetting resins and inert fillers. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids and alkalies.

Compressive Strength	ASTM C579	12,000 psi at 7 days
Tensile Strength	ASTM C307	2,000 psi minimum
Coefficient of Expansion	ASTM C531	30x10-6 in per degree F
Shrinkage	ASTM C827	None

2.3 NON-SHRINK CEMENTITIOUS GROUT

- A. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum

Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

2.4 FORMWORK

- A. Refer to Section 031000 for formwork requirements.

2.5 CURING

- A. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or with use of wet burlap method.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level and maintain final positioning of components to be grouted.
- E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.2 MIXING

- A. Portland Cement Grout:
1. Use proportions of 2 parts sand and 1 part cement, measured by volume.
 2. Prepare grout with water to obtain consistency to permit placing and packing.
 3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing 2 to 3 minutes.
 4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
 5. Do not add additional water after grout has been mixed.
 6. Capable of developing minimum compressive strength of 2400 psi in 48 hours and 7000 psi in 28 days.

***** [OR] *****

3.3 PLACING GROUT

- A. Place grout material quickly and continuously.
- B. Do not use pneumatic-pressure or dry-packing methods.
- C. Apply grout from one side only to avoid entrapping air.
- D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.
- E. Thoroughly compact final installation and eliminate air pockets.
- F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.4 CURING

- A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. After grout has attained its initial set, keep damp for minimum of 3 days.

3.5 FIELD QUALITY CONTROL

- A. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of Work.
- B. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

SECTION 04 05 14

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
 - 1. Section 042000 - Unit Masonry Assemblies: Installation of mortar and grout.
 - 2. Section 042016 - Reinforced Unit Masonry Assemblies: Installation of mortar and grout.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
 - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C91 - Standard Specification for Masonry Cement.
 - 3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 - 4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 6. ASTM C150 - Standard Specification for Portland Cement.
 - 7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
 - 8. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
 - 9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
 - 11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 12. ASTM C476 - Standard Specification for Grout for Masonry.
 - 13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
 - 14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
 - 16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
 - 17. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
 - 18. ASTM C1329 - Standard Specification for Mortar Cement.

19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal requirements.
- B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Portland Cement: ASTM C150, Type I
- B. Calcium chloride is not permitted.

2.2 MIXES

- A. Mortar Mixes:
 - 1. Extended Life Mortar: ASTM C1142, Type RS
- B. Mortar Mixing:
 - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
 - 2. Achieve uniformly damp sand immediately before mixing process.
 - 3. Re-temper only within two hours of mixing.
- C. Grout Mixes:

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1. Grout for Non-Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
 2. Grout for Structural Masonry: 3,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 grout.
 3. Application:
 - a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
 - b. Fine Grout: For grouting other spaces.
- D. Grout Mixing:
1. Mix grout in accordance with ASTM C94/C94M, modified to use ingredients complying with ASTM C476.
 2. Add admixtures; mix uniformly.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Request inspection of spaces to be grouted.

3.2 INSTALLATION

- A. Install mortar and grout in accordance with ACI 530.1 Specifications for Masonry Structures.

3.3 FIELD QUALITY CONTROL

- A. Establishing Mortar Mix: In accordance with ASTM C270.
- B. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.
- C. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.
- D. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.
- E. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

END OF SECTION

SECTION 04100
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 Mortar proofing
 - Sonneborn Building Products - Hydracide
 - W. R. Grace - Hydratite Plus
 - Krete
 - 4. **MORTAR COLOR:**
 - To match CMU color***
- 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, alkalies, or organic matter.
- F. WATERPROOFING ADMIXTURE:
 - 1. ***“Dry-Block” Integral Water repellant Admixture by WR GRACE Products.***
 - 2. ***“Krete Gard” Mortar mix integral water repellant admixture by Krete Industries.***
- G. GROUT ADMIXTURE: "Fluidifier" by Master Builders.
- H. GROUT SEALER: (at ceramic mosaic tile floor) Hydroment Dry Tile Grout by BOSTIK

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. ***Water repellant admixture – shall be proportioned as per manufactures recommendations.***
- 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 04 20 16

REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes concrete masonry units, reinforcement, anchorage, and accessories.
- B. Related Sections:
 - 1. Section 040514 - Masonry Mortar and Grout: Mortar and grout.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
 - 1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 4. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
 - 5. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
 - 8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
 - 9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 10. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
 - 11. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
 - 12. ASTM C55 - Standard Specification for Concrete Brick.
 - 13. ASTM C56 - Standard Specification for Structural Clay Non-Load-Bearing Tile.
 - 14. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
 - 15. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

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16. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
17. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
18. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
19. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
20. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
21. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
22. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
23. ASTM C315 - Standard Specification for Clay Flue Linings.
24. ASTM C530 - Standard Specification for Structural Clay Non-Loadbearing Screen Tile.
25. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
26. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
27. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
28. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
29. ASTM C1283 - Standard Practice for Installing Clay Flue Lining.
30. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
31. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
32. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Concrete Masonry Compressive Strength

1. Concrete Masonry Units: 1900 psi minimum net area compressive strength.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.

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B. Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement.

C. Product Data:

1. Submit data for masonry units and fabricated wire reinforcement.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

2.2 ACCESSORIES

A. Single Wythe Joint Reinforcement: ASTM A951; ladder type; 0.148 inch diameter side rods with 0.148 inch diameter cross ties.

B. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars.

C. Anchor Rods: ASTM A307; Grade C; J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15 inch embedment.

1. Hot-Dipped Galvanizing: ASTM A153/A153M.

2. Mechanical Galvanizing: ASTM B695; Class 55.

D. Mortar and Grout: As specified in Section 04065.

- E. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Test brick efflorescence in accordance with ASTM C67. Brick rated greater than “slightly effloresced” is not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.
- C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- D. Placing And Bonding:
 - 1. Lay solid masonry units in full bed of mortar, with full head joints.

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2. Lay hollow masonry units with face shell bedding on head and bed joints.
 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
 4. Remove excess mortar as Work progresses.
 5. Interlock intersections and external corners.
 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 8. Isolate masonry from vertical structural framing members with movement joint .
 9. Isolate top of masonry from horizontal structural framing members and slabs or decks.
- E. Joint Reinforcement And Anchorage:
1. Install horizontal joint reinforcement 16 inches oc.
 2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
 3. Place joint reinforcement continuous in first and second joint below top of walls.
 4. Lap joint reinforcement ends minimum 6 inches.
 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
 6. Embed anchors embedded in concrete attached to structural steel members. Embed anchorages in every sixth brick.
- F. Lintels:
1. Install precast concrete lintels over openings.
 2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
 3. Openings Up To 42 inches Wide: Reinforce openings as indicated on Drawings.
 4. Openings From 42 inches Up To 78 inches Wide: Reinforce openings as indicated on Drawings.
 5. Openings Over 78 inches: Reinforce openings as indicated on Drawings.
 6. Do not splice reinforcing bars.
 7. Support and secure reinforcing bars from displacement.
 8. Place and consolidate grout fill without displacing reinforcing.
 9. Allow masonry lintels to attain specified strength before removing temporary supports.
 10. Maintain minimum 8 inches bearing on each side of opening.
- G. Grouted Components:
1. Reinforce bond beam with 1, No. 5 bar.
 2. Reinforce pilaster with 1, No. 6 bar in each cell.
 3. Lap splices bar diameters required by code.
 4. Support and secure reinforcing bars from displacement.
 5. Place and consolidate grout fill without displacing reinforcing.

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6. At bearing locations, fill masonry cores with grout for minimum 12 inches either side of opening.
- H. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
 2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
 3. Splice reinforcement in accordance with Section 03200.
 4. Support and secure reinforcement from displacement.
 5. Place and consolidate grout fill without displacing reinforcing.
 6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.
- I. Control And Expansion Joints:
1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
 - a. Exterior Walls: 20 feet on center and within 10 feet on one side of each interior and exterior corner.
 - b. Interior Walls: 30 feet on center.
 - c. At changes in wall height.
 2. Do not continue horizontal joint reinforcement through control and expansion joints.
 3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
 4. Size control joint in accordance with Section 07900 for sealant performance.
 5. Form expansion joint by omitting mortar and cutting unit to form open space.
- J. Cutting And Fitting:
1. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.
- 3.4 ERECTION TOLERANCES
- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Alignment of Pilasters: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

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- G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- I. Maximum Variation for Steel Reinforcement:
 - 1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
 - 2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
 - 3. Plus or minus 1 inch when distance is between 8 and 24 inches.
 - 4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
 - 5. Plus or minus 2 inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

- A. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

- A. Section 017000 - Execution Requirements: Final cleaning.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.7 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION 04 20 16

SECTION 04211
CONCRETE MASONRY VENEER

PART 1 – GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE:

- A. General & Supplementary Conditions, Special Requirements.
- B. Concrete Reinforcement: Section 03210.
- C. Mortars and Grout: Section: 04065.
- D. Unit Masonry & Reinforcement: Section 04200.
- E. Concrete Masonry Units: Section 04220.
- F. Reinforced Unit Masonry: 04230.
- G. Through Wall Flashing: Section 04815.
- H. Metal Fabrications: Section 05500.
- I. Fluid Applied Waterproofing: Section 07140.
- J. Cavity Wall Insulation: Section 7217
- K. Caulking: Section 07951.
- L. Hollow Metal Doors & Frames: Section: 08100.
- M. Painting: Section 09900.
- N. Pre Engineered Metal Building: Section 13120.

1.02 REFERENCED DOCUMENTS:

- A. ASTM A 153: Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- B. ASTM A 615: Deformed and Plain Billet- Steel Bars for Concrete Reinforcement.
- C. ASTM A 951: Masonry Joint Reinforcement.
- D. ASTM C 33: Concrete Aggregates.
- E. ASTM C 90: Load bearing Concrete Masonry Units.
- F. ASTM C 129: Non load bearing Concrete Masonry Units.
- F. ASTM C 140: Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- G. ASTM C 150: Portland Cement.
- H. ASTM C 331: Lightweight Aggregates for Concrete Masonry Units.
- I. ASTM C 476: Grout for Masonry.
- J. ASTM C 920: Elastomeric Joint Sealants.
- K. ASTM D 2287 Non-rigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.03 SUBMITTALS:

- A. Product Data for CMU including Test Report per ASTM C 90.
- B. Sample Boards representing color and texture.

1.04 QUALITY ASSURANCE:

- A. Construct 8' high x 6' wide Sample Panel as directed at the site. Panel to represent range of color and texture of veneers, 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. Do not proceed with veneer work on the Project until sample panel has been approved for color and general assembly of all materials. Approved panel shall be the standard of comparison for workmanship and materials. Do not destroy, alter or move panel until veneer work is completed.
- B. Obtain all CMU from a single manufacturer: Headwaters Construction Material. Compressive strength of masonry $f'_m = 1500$ psi.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Masonry Contractor responsible for acceptance of delivered CMU per ASTM C 90.
- B. Protect CMU from precipitation or ground water, dust, mud or other contaminants. Store off ground.

1.06 PROJECT CONDITIONS:

- A. Do not apply construction loads that exceed the safe superimposed load-carrying capacity of the masonry and shores or braces, if used. Provide wind bracing.
- B. Follow Cold Weather Construction procedures for ambient temperature below 40° F.
- C. Follow Hot Weather Construction procedures for ambient temperature above 100° F or above 90° F with a wind velocity greater than eight miles per hour.

PART 2 – PRODUCTS

2.01 MORTAR MATERIALS:

- A. Provide Type S per ASTM C 270.
- B. Provide pre-bled Headwaters Construction Materials color mortar assigned to match Custom Colored CMU.
- C. ***Provide integral water-repellent mortar admix “Krete Gard” by Krete Industries, or “Blocktite” by Euclid Chemical Company, for all exterior walls.***

2.02 GROUT MATERIALS:

- A. Provide grout that conforms to the requirements of ASTM C 476. Do not use admixtures unless acceptable.

2.03 CONCRETE MASONRY UNITS:

- A. ***Exterior Veneer Concrete Masonry Units: Provide Colored Textured and Polished hollow load bearing CMU per ASTM C 90 requirements for normal weight units as manufactured by Headwaters Construction Materials. All custom units to be manufactured with an integral water-repellent Krete Block Gard. Colors and types as selected by Architect. Architectural units shall be manufactured in one continuous run to achieve color consistency. Size and shapes shall be manufactured “preformed” corners, trims and window sills at all required conditions where indicated on drawings or not.***
- B. ***Exterior Block Veneer:***
 - a. ***8”X8”X16” Polished CMU color as selected by architect.***

2.04 REINFORCEMENT AND METAL ACCESSORIES:

- A. Provide deformed reinforcing bars per ASTM A 615.
- B. Provide Joint Reinforcement that conforms to ASTM A 951. All reinforcement and anchors to be hot dip galvanized per ASTM A 153 as manufactured by Masonry Reinforcing corporation of America (Wire-Bond) or Dur-O-Wal.

2.05 ACCESSORIES:

- A. Refer to section 04815 Through Wall Flashing.
- B. Provide PVC contraction joint material conforming to ASTM D 2240 as manufactured by Wirebond.
- C. Provide expansion joint material conforming to ASTM C 920.
- D. Masonry Cleaners as manufactured by Pro-SoCo.
- E. ***Exterior Masonry wall water repellent and Graffiti Control refer to Section 09900 Painting.***
- F. Weep Holes: Cell Vent D/A 1006 Weep hole size to match CMU starter course color to match mortar joint color. By Dur-O-Wall or equal.

PART 3 – EXECUTION:

3.01 INSPECTIONS:

1. Prior to the start of masonry construction, the Masonry Contractor shall verify foundation tolerances conforming to the requirements of ACI 117. Furthermore, reinforcing dowel positions shall be verified to be located as indicated on the Construction Documents. Notify the Architect/Engineer if conditions are not meet.

3.02 PREPARATION:

- A. Clean all reinforcement.
- B. Prior to placing masonry, remove laitance, loose aggregate and anything else that would prevent mortar from bonding to the foundation.
- C. Do not wet CMU before laying.

3.03 MASONRY ERECTION:

- A. Construct masonry in a running bond with CMU centered over head joints.
- B. Unless otherwise required, construct 3/8" thick bed and head joints. Tool joints with concave type joint.
- C. Fully mortar web and face shells. Head joints shall be at least as thick as CMU face shell thickness.
- D. Place horizontal bed joint reinforcement 16" o/c. Start placement between first and second course, minimum lap 8", discontinue (terminate) at contraction and expansion joints and use Control Joint Anchors.
- E. Unless otherwise indicated on Construction Documents, lap reinforcing steel 40 bar diameters, but not less than 12". Sleeve bond beams 8" across contraction and expansion joints as indicated on Construction documents.
- F. Brace walls for stability of masonry during construction.
- G. Construction tolerances in accordance with ACI 503.1 'Specifications for Masonry Structures'.

3.04 GROUT PLACING:

- A. Place grout in low lifts not exceeding 8' unless otherwise noted on structural drawings.
- B. Consolidate grout at time of placement.

3.05 CLEANING:

1. Follow masonry cleaner manufacturer's procedures. Test sample panel to verify final results.

3.06 EXTERIOR WALL COATING:

1. Follow masonry water repellent manufacturer's procedures. Test sample panel to verify final results.
2. Note: Above-referenced Specification will vary with each Project. Refer to 'Specification for Masonry Structures' (ACI 530.1 / ASCE 6 / TMS 602) for properly choosing and specifying the necessary requirements for the Project Specifications.

END OF SECTION

SECTION 04220
CONCRETE UNIT MASONRY

PART 1: GENERAL:

1.01 SCOPE:

- A. Perform all Work required to complete the Concrete Unit 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.

1.02 PRODUCTS INSTALLED UNDER THIS SECTION BUT SPECIFIED ELSEWHERE:

- A. Section 04100 - Mortar.
- B. Section 07951 - Caulking.

1.04 SUBMITTALS:

- A. Submit technical data for each type wall reinforcement, anchors and ties.
- B. Submit 12" long sample of control joint filler.
- C. Submit certificate that masonry units conform to ASTM and NBFU standards specified.

1.05 STORAGE AND HANDLING:

- A. Handle materials in a manner to prevent breakage and chipping. Store materials on platforms raised free of ground and protect materials with stainproof tarpaulin covers.

1.06 ENVIRONMENTAL CONDITIONS:

- A. Lay no masonry when the temperature of the air is 40°F. or less or will fall below 40°F. twenty-four (24) hours after laying. Do not build on frozen work.
- B. Store masonry units on the job so that they are kept off the ground and protected from rain.

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:

Duro-O-Wal	AA Wire Products Company
Heckman Building Products, Inc.	Hohmann and Barnard, Inc.
Masonry Reinforcing Corp. of America	National Wire Products Corp.
Innovative Block Products of South Texas	
 - 2. Concrete Masonry Units:

- a. Headwaters Construction Materials
 - b. Innovative Block Products of South Texas
- B. Refer to Section 1631 - Substitutions and Product Options for manufacturers not listed above.

2.02 MATERIALS:

- A. UNITS:
- 1. Hollow Concrete Masonry: ASTM C90, medium, Grade N-1. (Refer to Structural Drawings).
- B. REINFORCEMENT:
- 1. Block Wall Joint Reinforcement for interior walls :
ASTM A82, AA Wire Products Co., "DUR-O-WALL TRUS", AA600 two wire, width 2" less than wall thickness, standard weight galvanized ASTM A116, Class 1.
 - 2. Lintel and Bond Beam Reinforcement: Domestic, ASTM A615, or ASTM A616, deformations ASTM A305. Unless otherwise shown on drawings provide 2 - #4 Ø cont. lap 30 dias.
- C. WATER: Clean and free of deleterious acids, alkalies or organic material.
- D. BULL NOSE:
- 1. Where 8" CMU is indicated on drawings at interior wall partitions, column furr outs and outside corner conditions, provide 1" radius single bull nose CMU. Provide double 1" radius bull nose CMU on door jambs and window jambs. First course shall be non-bull nose.
 - 2. Where 6" and 4" CMU is indicated on drawings at interior wall partitions, column furr outs and outside corner conditions, provide 1" radius single bull nose CMU. Provide non-bull nose CMU on interior door jambs and window jambs. First course shall be non-bull nose.
 - 3. Where exterior cavity walls with brick and block are indicated on drawings provide 1" radius single bull nose CMU on door jambs and window jambs. First course shall be non-bull nose.

PART 3: EXECUTION:

3.01 CONDITION OF SURFACES:

- A. Do not commence with masonry work until foundation has properly cured a minimum of seven (7) days and reinforcing steel that is dowelled for masonry units has been approved.
- B. Consult other trades and make provisions to permit installation of their work to avoid cutting and patching. Before closing up any pipe chase, duct chase or similar inaccessible spaces, remove all rubbish and sweep out areas to be enclosed.

3.02 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 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 free-standing walls to prevent windstorm damage until walls are protected.

- D. Examine surfaces to receive masonry and report any discrepancies before commencing work. Accept no former measurements, but lay work according to the plans and dimensions thereon.

3.03 LAYING CONCRETE MASONRY UNITS:

- A. Do not dampen units before laying, and do not lay units which have surface water or contain frost. Lay units plumb, level, and true to a line in running bond, or as indicated. Align on exposed face or as indicated.
- B. Lay first course of masonry in full bed of mortar. Lay all other hollow units in a full mortar bed on shell surface and at ends.
- C. Lay hollow units with the thicker edge of the face shell up and make all joints 3/8" thick. Lay corners prior to laying mid-portion of wall. Rock closures into place with the head joints shoved against the two adjacent units in place.
- D. Cut units with power saw through the unit to insure straight, evenly cut edges. Do not use fractional parts of masonry units in the work where whole units can be used.
- E. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after setting in place. Remove mortar and replace with fresh mortar where adjustment must be made after initial settings.
- F. Do not use masonry units having cracks, chipped edges, broken corners or other defects in exposed faces. Build walls full thickness as shown. Blocks with open cells exposed will not be permitted.
- G. Provide all special precast lintels, fillers, closers, control joint units, trough tile, etc., required to form all corners, returns, openings, jambs, offsets, etc., to maintain a proper bond throughout all masonry work.
- H. Protect all sills, ledges, off-sets, etc., from droppings of mortar and protect door jambs and corners from damage during construction.
- I. Stop off longitudinal run of masonry only where absolutely necessary by racking one-half block length in each course. Remove loose mortar before new work is started.
- J. Cover tops of walls at end of day's work and when rain is imminent, with waterproof membrane. Overhang two feet on each side of wall and anchor securely. Protect masonry from weather or construction damage.

3.04 JOINTS:

- A. Mortar joints shall be straight, clean and uniform in thickness. Tool joints of all walls to produce a dense surface well bonded to the edges. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled.
- B. Tool when the mortar is partially set but still sufficiently plastic to bond. Use a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.
- C. Finish joints that will remain exposed with a tool slightly larger than the width of the joint to form a concave surface. Tool vertical joint first. Finish flush, joint that will not remain exposed.
- D. Unless otherwise specified the horizontal and vertical mortar joints shall be 3/8" thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled with grout.

SECTION 04220
CONCRETE MASONRY UNIT

- E. Vertical head joints shall be buttered well for a thickness equal to the face shell of the unit and these joints shall be shoved tightly so that the mortar bonds with both units. Joints shall be solidly filled from the face of the block to at least the depth of the face shell.

3.05 REINFORCING:

- A. Install continuous joint reinforcing 16" on centers for running bond. Install joint reinforcing in the first and second bed joint above and below openings extending 24" beyond each side of opening.
- B. Lap splices a minimum of 6" and install prefabricated corners and tees at such locations. Do not extend reinforcing through expansion joints. Center reinforcing in joint with 5/8" minimum mortar coverage on the exterior face and 1/2" minimum mortar coverage on interior face.
- C. Do not extend reinforcing through control joints when anchorage is provided on each side of joint. If no anchorage is provided at joint, extend reinforcing through control joint at 48" on center.
- D. Reinforce bond beams and lintels as indicated with continuous bars placed as the work progresses. Maintain 1/2" minimum clear distance between masonry units and reinforcement.

3.06 ANCHORING:

- A. Anchor interior partitions to abutting or intersecting walls by common bond or with prefabricated reinforcing tees.
- B. Anchor interior load bearing partitions laterally by either an intersecting partition or anchorage to foundation, fill cells to top of wall.
- C. Do not attach construction supports to wall except where specifically permitted by the Architect.
- D. Intersecting load bearing masonry walls and partitions shall be bonded by the use of rigid steel anchors at twenty-four (24) inches o.c. maximum. Corners shall have a standard masonry bond by overlapping units and shall be solid grouted.

3.07 CONTROL JOINTS:

- A. Locate 3/8" wide control joints as indicated but do not exceed 50 feet on centers. Keep vertical joints straight, true and continuous from top to bottom of masonry.
- B. Use sash units to form control joints and install continuous control joint filler with sash units tightly butted to compress neoprene flanges and completely seal joint. Where masonry abuts structural concrete or steel and control joint filler cannot be used, keep joint clean of mortar as work progresses or use expansion joint spacer.
- C. Locate building expansion joints as indicated and install expansion joint spacer properly recessed back from face to allow for sealant.

3.08 EMBEDDED ITEMS:

- A. Build in flashing, sleeves, anchors, clips, mechanical and electrical items, and accessories as work progresses. Accurately cut units to fit all plumbing, ducts, openings and electrical work with all holes neatly patched.
- B. Install loose lintels, as indicated, in full beds of mortar. Fill voids at metal frames with mortar and build in frame anchors.

3.09 GROUTING:

- A. Fill with grout, vertical cells, bond beams, lintels and other structural members having reinforcement. Secure in place and inspect reinforcing before grouting. Keep mortar droppings out of grout space and puddle or vibrate all grout in place.
- B. Provide solid bearing under structural members at least 8" vertically and at least 16" horizontally. Bearing shall be hollow units reinforced with 2 #4 Ø bars U.N.O. and filled with concrete grout.
- C. Build masonry in filled cell construction to preserve the unobstructed vertical continuity of the cells to be filled. Fully bed all walls and cross webs forming such cells to prevent leakage of grout and strike cell joints smooth. Maintain a continuous vertical alignment of cells so the unobstructed cell area is not less than 2"x3".
- D. Grout vertical cells in lifts not to exceed 4'-0". Stop grout where necessary at mid-point but not over openings, when filling trough unit and provide suitable dam to retain grout. Stop grout one and one half inches below the top of the last course when filling vertical cells to form key for next pour.
- E. Grout from inside face of masonry and prevent grout from staining masonry face. Protect projecting surfaces from droppings and clean immediately any grout which comes in contact with face of masonry.

3.10 CLEANING:

- A. Keep face of blockwork free from excess mortar while laying blocks. Clean blockwork that will remain exposed, promptly, with fiber brushes and clear water. Use of wire brushes or acid permitted only with specific approval.
- B. Repair and repoint defective work and pin line holes to match adjacent similar work. Replace broken or damaged blocks.

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

Manufacturer:

1. Continental Cast Stone Manufacturing, Inc. Dallas, Texas.
2. Custom Cast Stone Manufacturing – 1-888-776-9960, Indiana.

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 exposed 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 apply 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.

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CAST STONE

- 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 04815

THROUGH-WALL FLASHING SYSTEM

PART 1 - GENERAL

1.01 GENERAL

- A. Contractor shall review American Concrete Institute 530.1 mandatory specification checklist for additional requirements necessary for specific project.

1.02 QUALITY ASSURANCE

- A. At a scheduled pre-construction meeting with all trades, contractor shall review flashing for the project and how the flashing shall be sequenced with the following: below grade waterproofing, air and vapor system, window installation, sealant installation, relief angles and roofing.
- B. Manufacturer shall have a Representative inspect installation a minimum of one time per week.

1.03 SUBMITTALS

- A. Shop Drawings: Contractor shall provide from the manufacturer a review of the flashing design for the project and location of preformed shapes on reduced floor plan.

1.04 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. 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 a minimum of four inches (4") off the substrate, and the tarpaulin tied off with rope.
- C. Deliver materials in sufficient quantity to allow continuity of work.
- D. Handle and store material in such a manner as to avoid damage.
- E. Protect materials against damage by construction traffic.
- F. Storage: All materials should be stored under cover to avoid site damage. During cool weather construction, store materials inside at 50° F or higher.
- G. The proper storage of materials is the sole responsibility of the contractor and damaged materials shall be discarded, removed from the project site, and replaced prior to application.

1.05 SITE CONDITIONS

- A. Job Condition Requirements: 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 contractor shall follow local, state, and federal regulations, safety standards, and codes. When a conflict exists, use the stricter document.

SECTION 04815
THROUGH - WALL FLASHING SYSTEM

- 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 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.
- 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 shall 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.
 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. At completion, all work areas shall be left clean and all contractor's equipment and materials removed from the site.
 3. Debris shall be deposited at an approved disposal site.

1.06 WARRANTY:

- A. Flashing Manufacturer: Project shall be installed in such a manner that the flashing material manufacturer will furnish a written ten (10) year materials warranty from the date of substantial completion of the completed project.

PART 2 - PRODUCTS

2.01 BUILT-IN FLASHING MEMBRANE (ELVALOY SHEET)

- A. The built-in flashing membrane shall be 40 mil flexible sheet material, consisting of a blend of elastomeric and thermal plastic polymers, incorporating DuPont™ Elvaloy. The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to width.
- B. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends, and special applications.

Physical Properties

Elongation	175%	ASTM D412
Tensile Strength	650 psi	ASTM D412
Tear Strength	280 psi	ASTM D624
Low Temperature Flexibility	-25° F Pass	ASTM D146
Water Absorption	Less than 0.1%	ASTM D471

SECTION 04815
THROUGH - WALL FLASHING SYSTEM

2.02 RELATED MATERIALS FOR BUILT-IN FLASHING MEMBRANE

- A. Flashing Membrane Adhesive: Flashing adhesive exceeds the requirements of TTS00230C Type II, Class B, ASTM C 92094 and Canadian Spec CAN 19, 13M82. The product is terra cotta (dull red) in color.

Physical Properties

Hardness Shore A	24 ± 3	ASTM C 661
Shear Strength	75 psi	ASTM D 1002
Tack Free Time	25 minutes	ASTM C 679
Slump (sag)	Zero slump	ASTM C 697
Shrinkage	No measurable shrinkage after 14 days	
Low Temperature Flexibility	-20° F pass 1/4 inch mandrel	
Service Temperature	-40° F to 200° F continuous service	
Shelf Life	One year	

2.03 SURFACE-ADHERED WITH DRIP FLASHING MEMBRANE (ELVALOY SHEET)

- A. Surface-adhered with drip membrane shall be a composite 40 mil membrane consisting of 25 mils of elastomeric/thermal plastic membrane incorporating DuPont™ Elvaloy and 15 mils of SBS asphaltic adhesive. The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to standard widths.

- B. Standard Sheet Dimensions:
- | | |
|-------------|-------------------|
| Thickness | 40 mil |
| Roll length | 75 ft |
| Roll widths | 12, 18, 24, 36 in |

- C. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends, and special applications.

Physical Properties

Elongation	225%	ASTM D412
Tensile Strength	875 psi	ASTM D412
Tear Strength	270 psi	ASTM D624
Low Temperature Flexibility	-25° F Pass	ASTM D146
Water Absorption	Less than 0.1%	ASTM D471

2.04 RELATED MATERIALS FOR SURFACE ADHERED FLASHING MEMBRANE

- A. Asphalt Primer: Shall be a two-sided, self-adhering tape used to seal the top of cloaks against the back-up wythe. Adhesive may be used as an alternative.

- B. DensGlass Primer:

Physical Properties

Solids by Weight	68%	
Viscosity	758 cps	
Weight per Gallon	9.3 lbs.	
Elongation	>656% no Breakage, Exceeded Travel of Instron	ASTM D 2370
Tensile Strength	85.1 psi	ASTM D 2370
pH	10	
Hardness Shore A	59	
Peel Strength	Aluminum No Fail at 4.60 pli	
	Concrete No Fail at 3.86 pli	

SECTION 04815
THROUGH - WALL FLASHING SYSTEM

- C. Mastic: Shall be used at all laps and joints, and top terminations.

2.05 WALL DRAINAGE SYSTEM

- A. Collection device shall be a dovetail shaped material to place in the cavity of brick masonry walls for collecting mortar droppings above the level of the weep holes and flashing. The 90% open weave construction material shall be High Density Polyethylene (HDPE) mesh for thickness of 0.4 – 1.0 inch, or recycled polyester mesh for 2.0 inch thickness.
- B. Material shall not oxidize, rot, promote mold or fungus, or react with other common building materials such as mortar, cement, asphalt, modified bitumen, PVC, copper, or galvanized metal; shall be Mortar Net, or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other specific conditions.

3.02 GENERAL

- A. Laying Masonry Walls: Use an inverted lintel CMU or fully grouted hollow CMU as a base for flashing at sills, floor joints, and other similar conditions.
- B. Preparation: All sharp protrusions and mortar droppings must be removed from the substrate, and the surface must be clean and dry.
- C. Where brick work occurs about the roof elevation, provide solid protection of the existing roof system until work is complete.
- D. Flashing shall be fully supported when crossing the cavity except at sill and coping locations.

3.03 INSTALLATION OF BUILT-IN FLASHING MEMBRANE (ELVALOY SHEET)

- A. Flashing membrane and cloaks shall be installed in a bed of fresh mortar and should extend through the outer wythe a minimum of ¼" and left exposed. Flashing membrane is UV resistant.
- B. Weep holes shall be provided immediately above all flashing at 24-inch centers. A minimum of two weeps shall be installed above any wall opening.
- C. All joints in the flashing membrane shall be lapped a minimum of four inches (4") using flashing membrane adhesive.
- D. Flashing membrane shall be installed six inches (6") above finished grade level.
- E. Cloaks and end dams shall be installed at all window and door heads and sills.
- F. Vertical flashing at wall openings shall extend into the wall opening one inch (1"). The door/window frame shall be installed with the flashing extending into the frame.

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THROUGH - WALL FLASHING SYSTEM

- G. Cleaning: Flashing membrane shall not be damaged by cavity cleaning after installation. Precautions to be taken during subsequent work are:
1. Use of cavity battens to prevent mortar droppings;
 2. Removal of droppings before they harden;
 3. Never use implements such as steel rods for cleaning the cavity; and
 4. Inspection of cavity flashing for damage as the work proceeds.

3.04 **INSTALLATION OF SURFACE-ADHERED FLASHING WITH DRIP MEMBRANE (ELVALOY SHEET)**

- A. Priming: All flashing substrates shall be primed. Flashing primer shall be applied with a brush, roller or sprayed. Coverage is approximately 400 square feet per U.S. gallon (3.78L). Drying time may vary depending on temperature, humidity, and air movement; drying time should be approximately 45 minutes.
- B. Flashing System Installation: Starting at a corner, mount cloak to substrate flashing adhesive. Cut surface adhered membrane into workable sections (8'-10'). Remove the release sheet and adhere the membrane to the inner leaf of construction lapping the membrane onto the cloak four inches (4"). Use firm hand pressure and a steel roller to totally adhere membrane in place. Extend membrane completely through the outer leaf and leave it exposed ¼" minimum. The surface-adhered membrane is UV resistant. Apply a bead of flashing mastic to all top termination edges.
- C. Termination Bar: The surface-adhered membrane shall be installed using a termination bar for additional attachment to the inner leaf (optional).
- D. Weep holes shall be provided immediately above all flashing at 24-inch centers. A minimum of two baffle weeps shall be installed above any wall opening.
- E. Flashing membrane shall be installed six inches (6") above finished grade level.
- F. Stop end cloaks shall be installed at all windows, door heads, sills, and through-wall starts, stops, steps, etc.
- G. Enveloped vertical flashing at wall openings shall extend into the wall opening one inch (1"). The door/window frame shall be installed with the flashing extending into the frame. Enveloped vertical flashing shall be installed at all abutments of dissimilar exterior wall treatments: inside and outside nineties (90°), etc.
- H. Cleaning: Flashing membrane shall not be damaged by cavity cleaning after installation. Precautions to be taken during subsequent work are:
1. Use of cavity battens to prevent mortar droppings;
 2. Removal of droppings before they harden;
 3. Never use implements such as steel rods for cleaning the cavity; and
 4. Inspection of cavity flashing for damage as the work proceeds.

3.05 **FLASHING MEMBRANE ADHESIVE**

- A. Application:
1. Flashing adhesive shall be applied to clean, dry and relatively smooth surfaces.
 2. When joint two (2) pieces of flashing membrane, or joining flashing membrane to Cloaks:
 - a) Apply two (2) one-fourth inch (1/4") beads of adhesive approximately one-half inch (1/2") and one and one-half inch (1-1/2"), respectively, from the edge of the bottom membrane along the entire width of the bottom membrane. Overlap the top membrane over the bottom membrane two inches (2") and roll lap with steel hand roller, causing excess to extrude the entire length of the overlap.
 3. Do not remove excess adhesive.

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THROUGH - WALL FLASHING SYSTEM

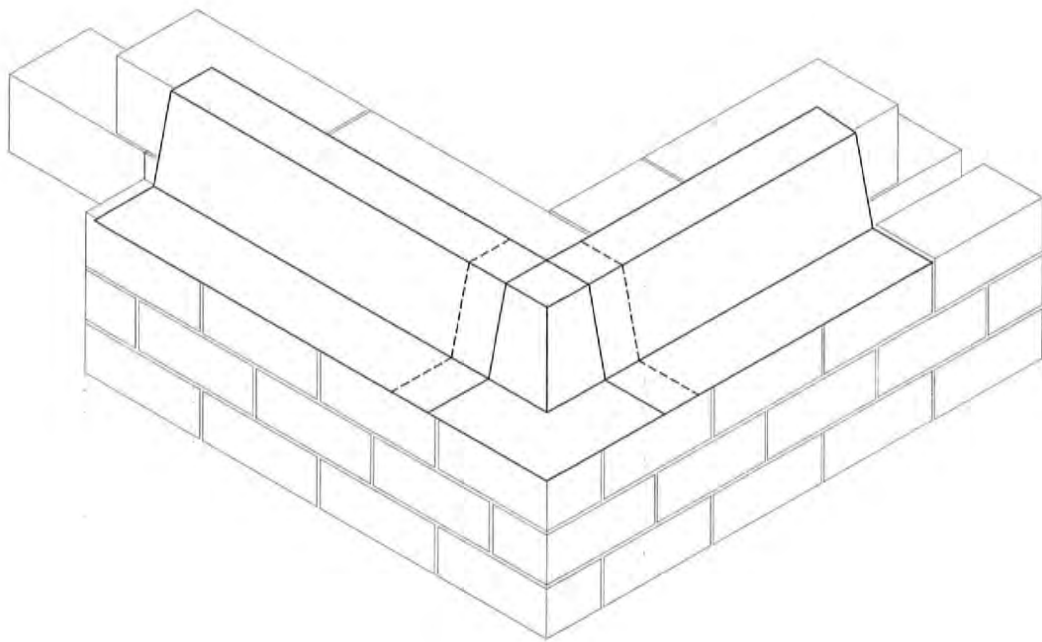
- B. Safety, Storage and Handling: Keep container tightly closed when not in use. Store at room temperature. Clean up tools and hands with waterless hand cleaner.

3.06 DENSGLASS PRIMER

- A. Surface Preparation: Areas to be primed should be dry.
- B. Application: DensGlass primer may be applied using a soft roller or brush. It can be removed from masonry with soapy water while wet and a solvent-based cleaner if dry (mineral spirits or citrus cleaner).
- C. Coverage: Depending on the condition of the surface, coverage may vary from as little as 150 square feet to 200 square feet per gallon.
- D. Caution:
1. DensGlas primer should not be applied when temperatures are below 40° F or when rain is imminent.
 2. Keep Dens Glass Primer from freezing.
 3. During hot weather, the product should be stored in a cool shaded area.
 4. Do not thin this product.
 5. Curing rates will vary depending on the ambient temperature relative humidity, wind speed, sky condition and the proper rate of application. Generally speaking, DensGlass primer will dry within 15 to 30 minutes when applied at 70° F or above. At 50° F, on a cloudy day, cure time may be extended to as much as one hour.
 6. Check several places on primed area for dryness prior to proceeding with the flashing application.

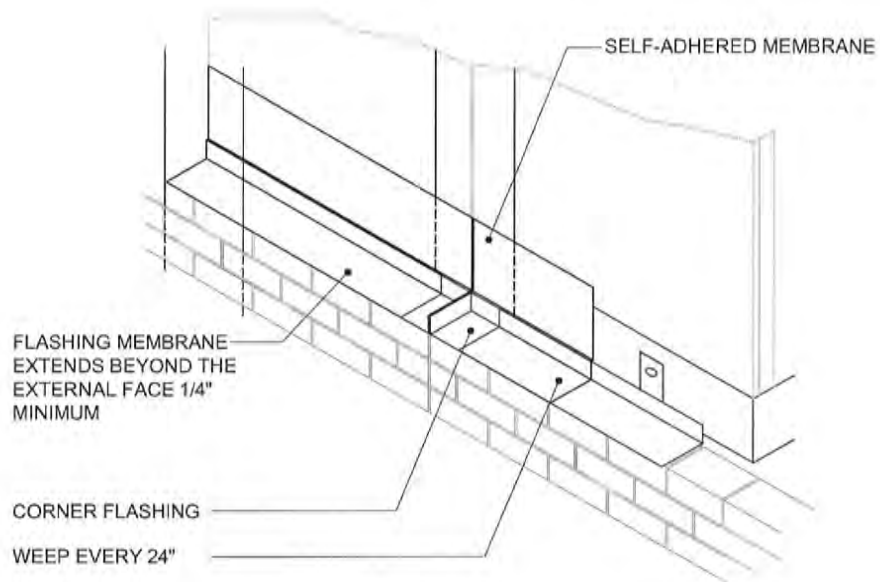
END OF SECTION

SECTION 04815 - ILLUSTRATIONS	
04815-7	BUILT-IN FLASHING
04815-8	FLASHING AT CONTROL/EXPANSION JOINT
04815-9	WINDOW SILL FLASHING
04815-10	WALL FLASHING AT LINTEL
04815-11	WINDOWS FLASHING DETAIL
04815-12	CLOAK FLASHING DETAIL
04815-13	EXTERIOR CORNER DETAIL
04815-14	INTERIOR CORNER FLEXIBLE EMBED
04815-15	EXTERIOR VERTICAL CONTROL JOINT FLEXIBLE EMBED
04815-16	DETAIL 1 SILL
04815-17	DETAIL 2 JAMB
04815-18	DETAIL 3 THRESHOLD

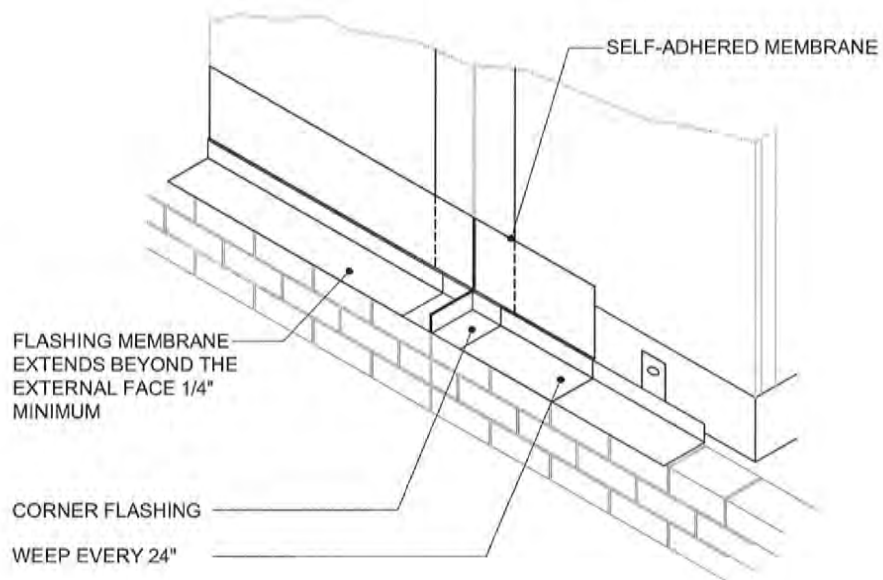


BUILT-IN FLASHING

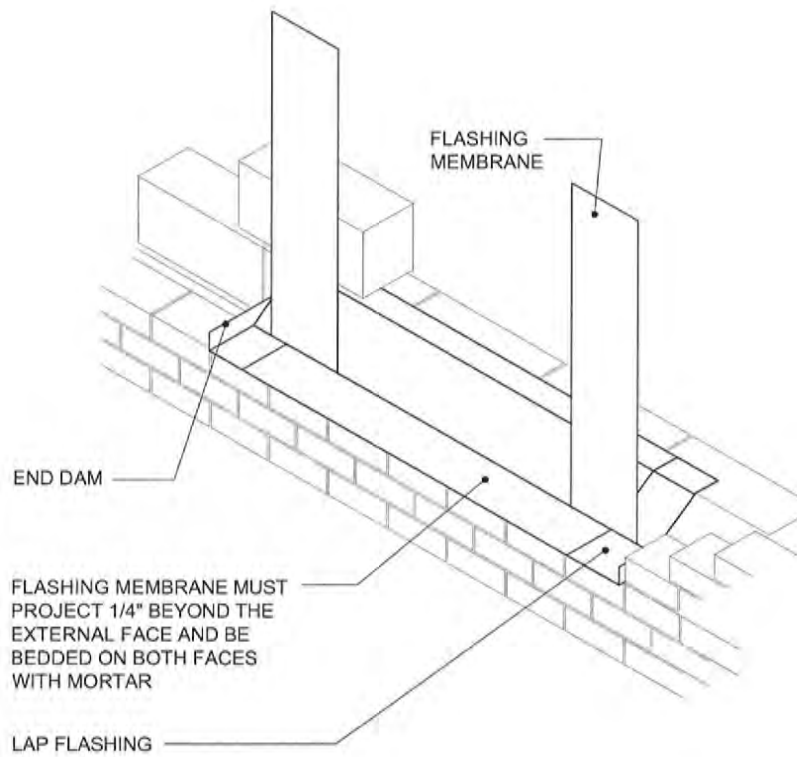
SECTION 04815-7



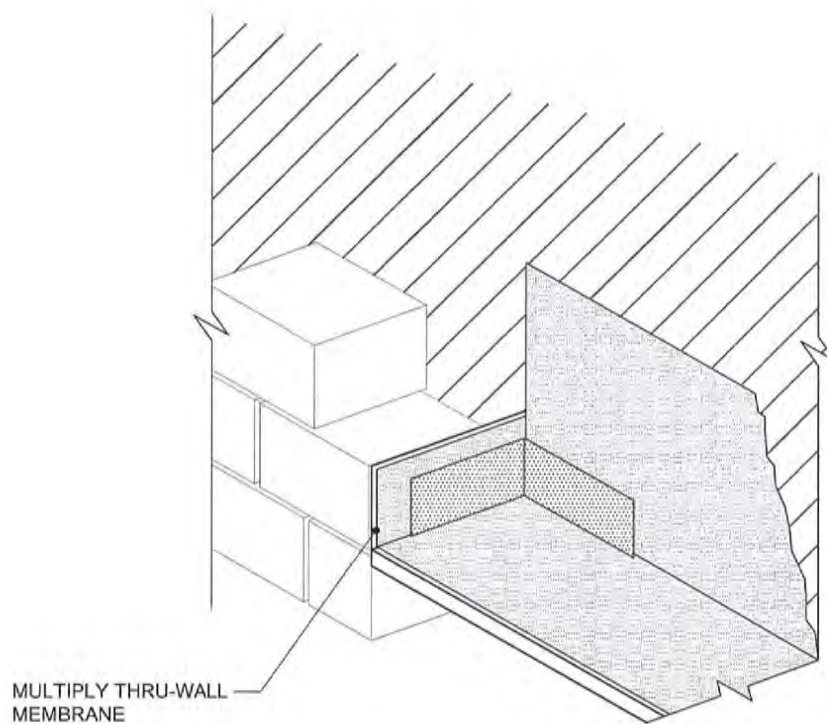
FLASHING AT CONTROL JOINT/EXPANSION JOINT



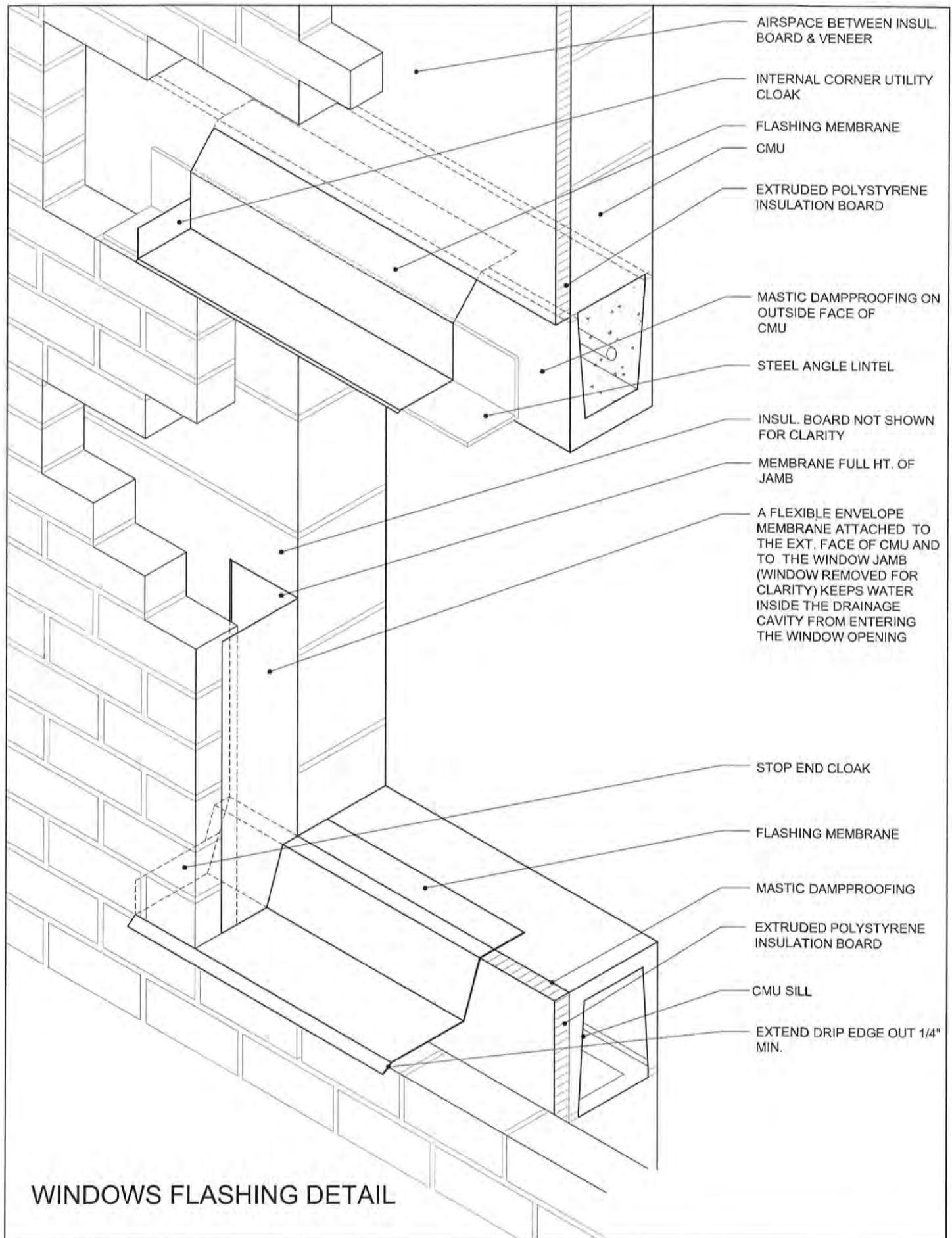
FLASHING AT EXPANSION JOINT



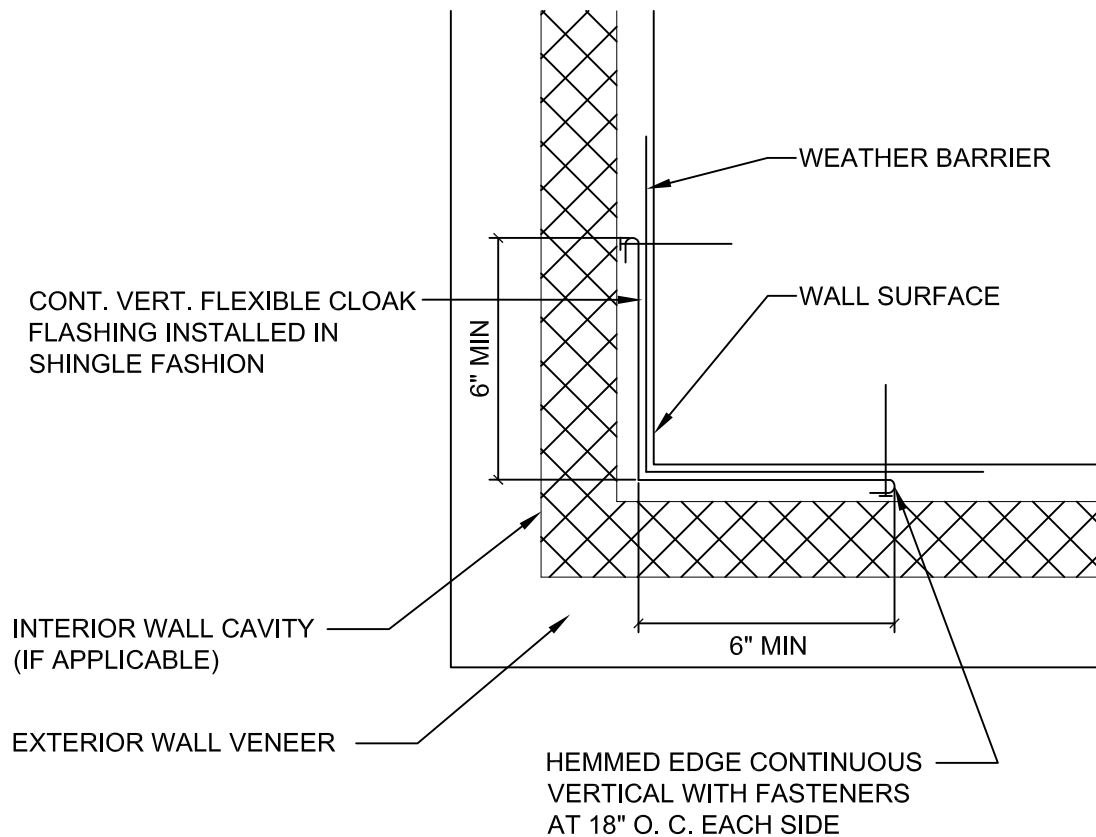
WINDOW SILL FLASHING



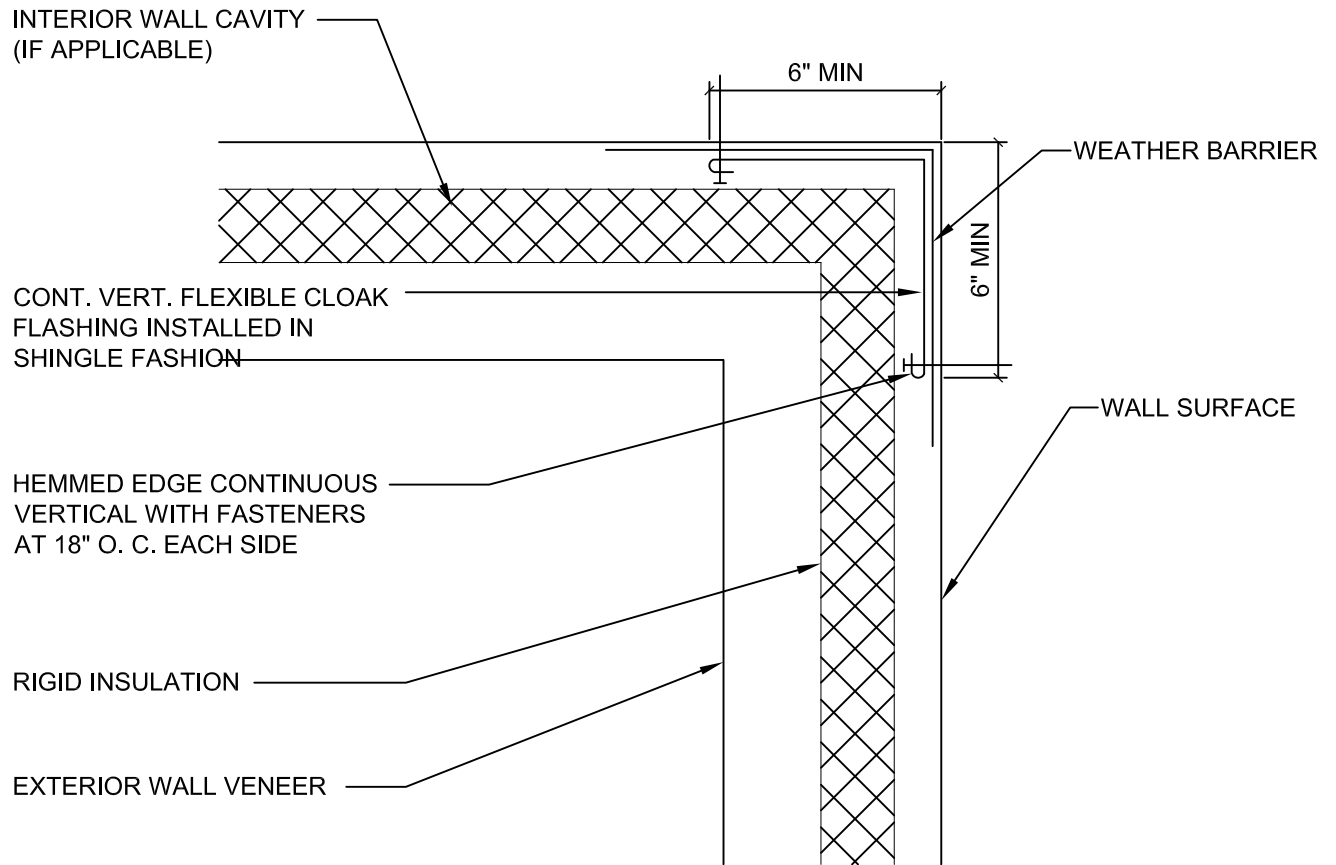
WALL FLASHING AT LINTEL



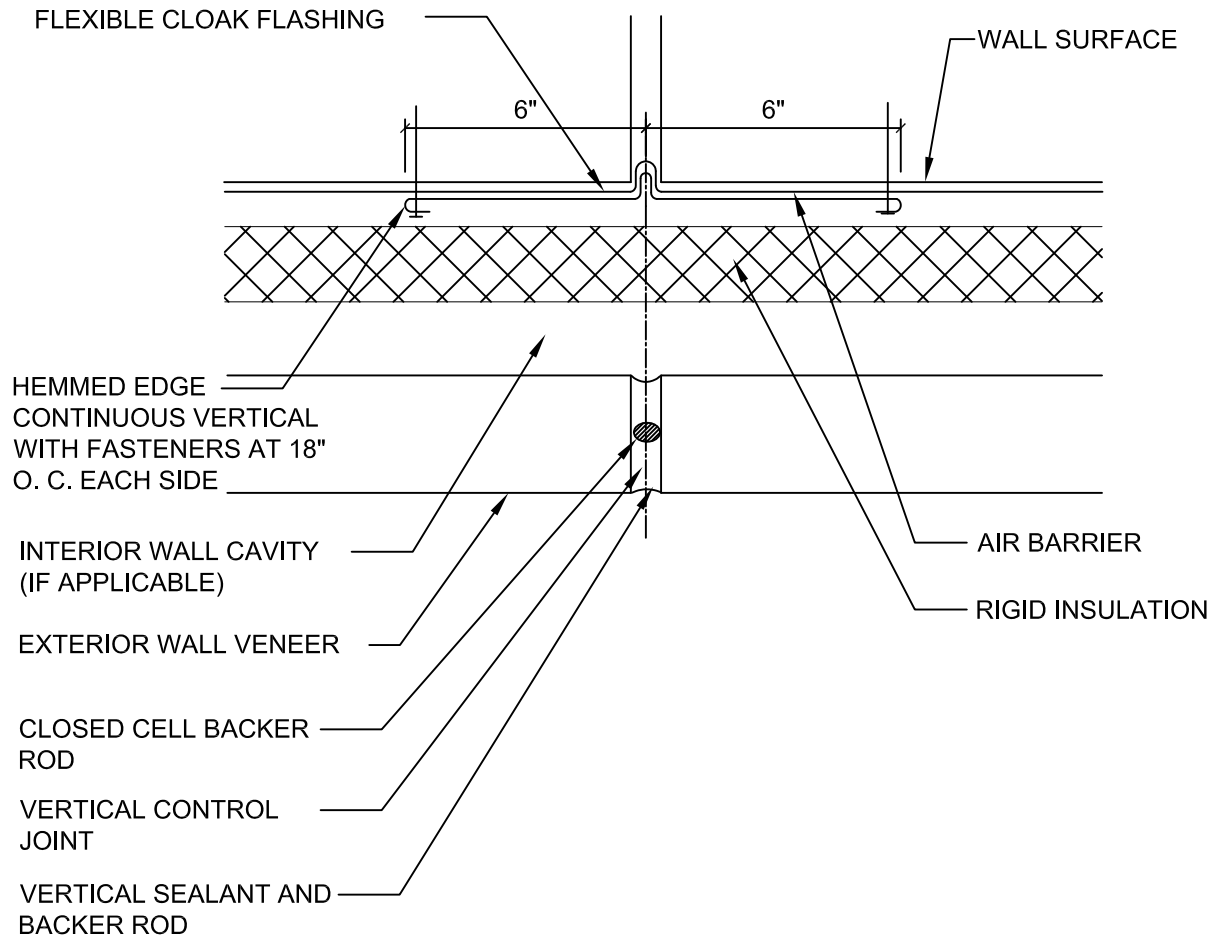




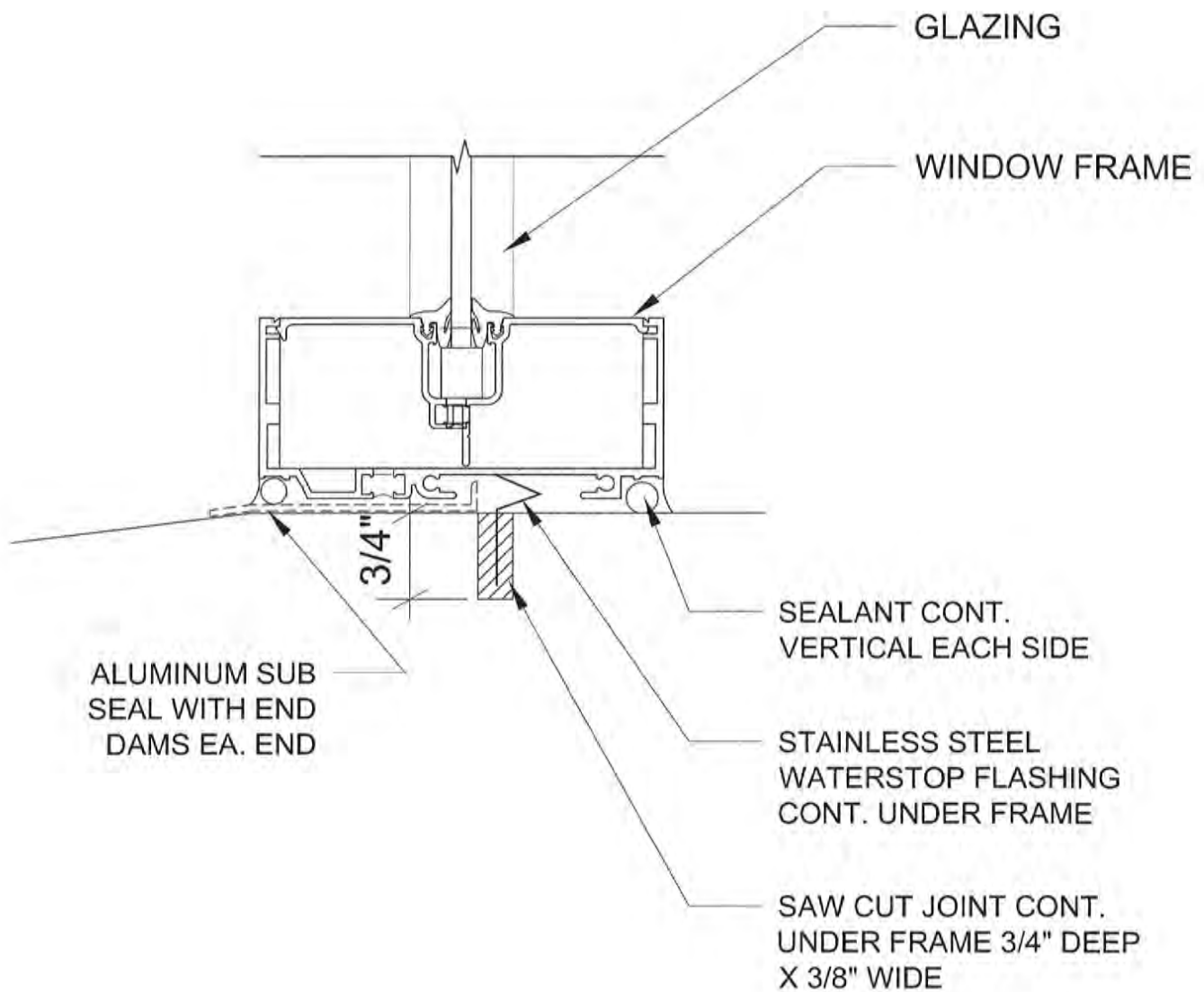
VERTICAL FULL HEIGHT EXTERIOR CORNER DETAIL



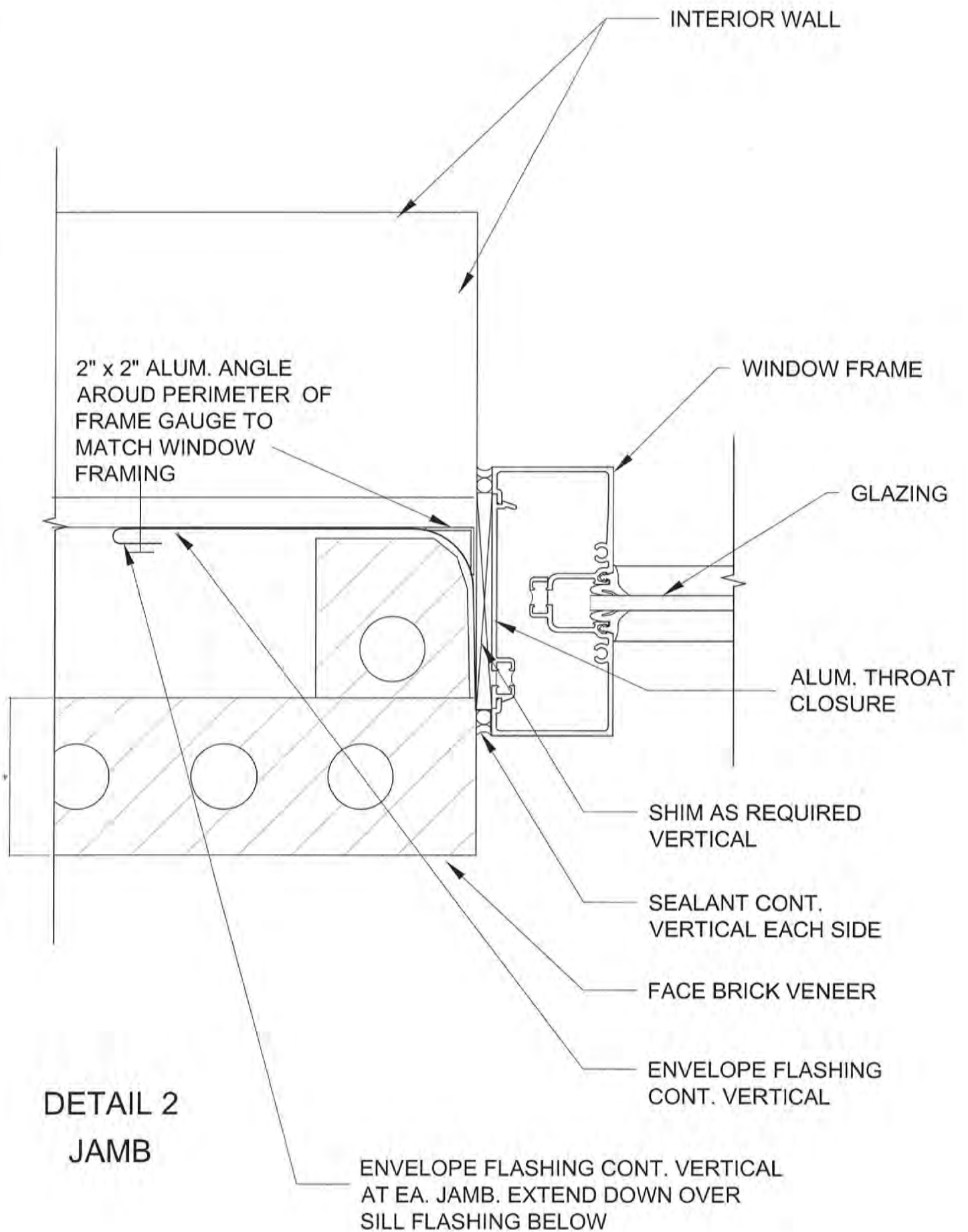
VERTICAL FULL HEIGHT INTERIOR CORNER DETAIL

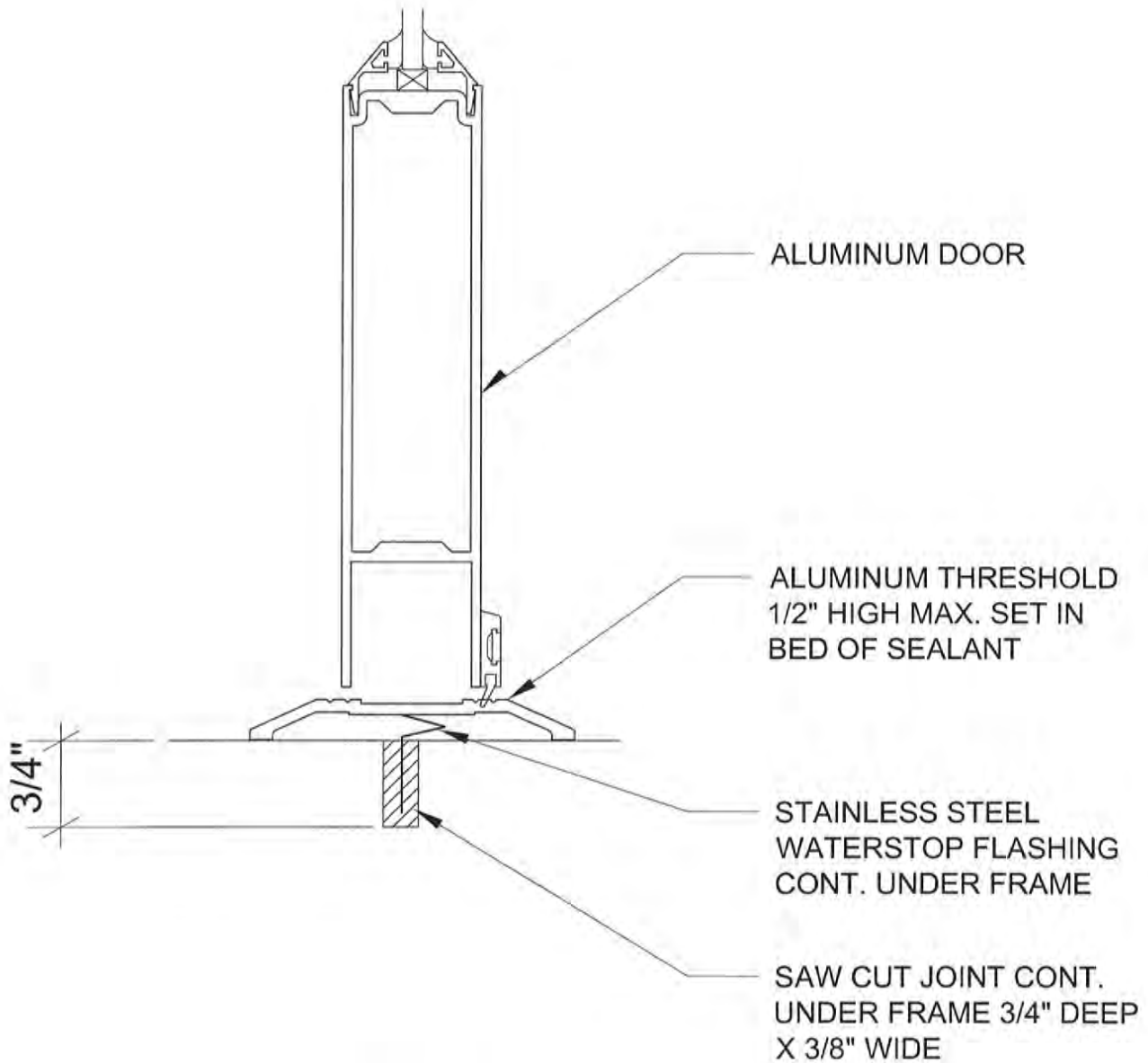


EXTERIOR VERTICAL CONTROL JOINT DETAIL



DETAIL 1
SILL





DETAIL 3
THRESHOLD

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural shapes.
 - 2. Channels and angles.
 - 3. Hollow structural sections.
 - 4. Structural pipe.
 - 5. Structural plates and bars.
 - 6. Fasteners, connectors, and anchors.
 - 7. Fasteners, connectors, and anchors.
 - 8. Grout.
- B. Related Sections:
 - 1. Section 036000 - Grout: Grout for setting base plates.
 - 2. Section 052100 - Steel Joists.
 - 3. Section 053123 - Steel Roof Deck
 - 4. Section 055000 – Metal Fabrications: Steel Fabrications affecting structural steel work.

1.2 REFERENCES

- A. American Institute of Steel Construction:
 - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 2. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
 - 3. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
 - 4. AISC Seismic Provisions for Structural Steel Buildings.
 - 5. AISC Specification for Allowable Stress Design of Single-Angle Members.
 - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
 - 7. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
- B. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

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4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
8. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
10. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
11. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
15. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
16. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A588/A588M - Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-in. (100-mm) Thick.
19. ASTM A618 - Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
20. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
21. ASTM A847 - Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.
22. ASTM A852/A852M - Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick.
23. ASTM A913/A913M - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST).
24. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
25. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

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26. ASTM E94 - Standard Guide for Radiographic Examination.
 27. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments.
 28. ASTM E165 - Standard Test Method for Liquid Penetrant Examination.
 29. ASTM E709 - Standard Guide for Magnetic Particle Examination.
 30. ASTM F436 - Standard Specification for Hardened Steel Washers.
 31. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 32. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 33. ASTM F1852 - Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. Research Council on Structural Connections:
1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
 2. SSPC Paint 15 - Steel Joist Shop Paint.
 3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
 4. SSPC SP 3 - Power Tool Cleaning.
 5. SSPC SP 6 - Commercial Blast Cleaning.
 6. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
 2. Connections.
 3. Cambers
 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Mill Test Reports: Submit indicating structural strength and destructive and non-destructive test analysis.
- D. Manufacturer's Mill Certificate: Certify products meet or exceed specified requirements.

- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualifications within previous 12 months.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 2. AISC Code of Standard Practice for Steel Buildings and Bridges. Section 10.
 - 3. AISC Seismic Provisions for Structural Steel Buildings.
 - 4. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
 - 5. AISC Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings.
 - 6. AISC Specification for the Design of Steel Hollow Structural Sections.
 - 7. AISC Specification for Allowable Stress Design of Single-Angle Members.
 - 8. AISC Load and Resistance Factor Design Specification for Single-Angle Members.
 - 9. RCSC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
 - 10. ASCE 19.

1.5 COORDINATION

- A. Section {013000 - Administrative Requirements}: Requirements for coordination.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992/A992M; Grade 50
- B. Structural M-Shapes: ASTM A36/A36M; Grade 50
- C. Structural T-Shapes: Cut from structural W-shapes.
- D. Channels and Angles: ASTM A36/A36M.
- E. Round Hollow Structural Sections: ASTM A500, Grade B.
- F. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade B.
- G. Structural Plates and Bars: ASTM A36/A36M.

2.2 FASTENERS, CONNECTORS, AND ANCHORS

- A. Bolts: ASTM A307; Grade A or B.
 - 1. Finish: Unfinished
- B. High Strength Bolts: ASTM A325; Type 1 or ASTM A490; Type 1.
 - 1. Finish: Unfinished
- C. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Unfinished
- D. Washers: ASTM F436; Type 1, circular
 - 1. Finish: Unfinished
- E. Threaded Rods: ASTM A36/A36M; Grade A.
 - 1. Finish: Unfinished
- F. Forged Structural Steel Hardware:
 - 1. Clevises and Turnbuckles: ASTM A108; Grade 1085.
 - 2. Eye Nuts and Eye Bolts: ASTM A108; Grade 1030.
 - 3. Sleeve Nuts: ASTM A108; Grade 1018.
 - 4. Rod Ends, Yoke Ends and Pins, Cotter Pins, and Coupling Nuts: Carbon steel.

2.3 WELDING MATERIALS

- A. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ACCESSORIES

- A. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi at 28 days
- B. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

2.5 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.
- C. Develop required camber for members.

2.6 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 3.
- B. Shop prime structural steel members.
- C. Galvanizing for Structural Steel Members: ASTM A123/A123M; minimum 1.2 oz/sq ft coating thickness; galvanize after fabrication.
- D. Galvanizing for Fasteners, Connectors, and Anchors:
 - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
 - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Shop test bolted and welded connections as specified for field quality control tests.
- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify bearing surfaces are at correct elevation.
- C. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

- A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

- A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field weld components and shear connectors indicated on Drawings.
- C. Field connect members with threaded fasteners; tighten to snug tight for bearing type connections.
- D. Do not field cut or alter structural members without approval of Architect/Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

- A. Grout [under base plates in accordance with Section 036000.
- B. Shim bearing plates and equipment supports to proper elevation, snug tighten anchor bolts.
- C. Fill void under bearing surface with grout. Install and pack grout to remove air pockets.
- D. Moist cure grout.
- E. Remove forms after grout is set. Trim grout edges to form smooth surface, splayed 45 degrees.
- F. Tighten anchor bolts after grout has cured for a minimum of 3 days.

3.5 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Bolted Connections: Inspect in accordance with AISC specifications.
 - 1. Visually inspect all bolted connections.

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2. For Direct Tension Indicators, comply with requirements of ASTM F959. Verify that gaps are less than gaps specified in Table 2.
- C. Welding: Inspect welds in accordance with AWS D1.1.
1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 2. Visually inspect all welds.
 3. Ultrasonic Inspection: ASTM E164; perform on all full penetration welds.
 4. Liquid Penetrant Inspection: ASTM E165.
- D. Correct defective bolted connections and welds.

END OF SECTION

SECTION 05 21 00

STEEL JOISTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
- B. Related Sections:
 - 1. Section 051200 - Structural Steel: Superstructure framing.
 - 2. Section 053110 – Steel Floor Deck
 - 3. Section 053123 - Steel Roof Deck
 - 4. Section 055000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.2 REFERENCES

- A. American Institute of Steel Construction:
 - 1. AISC Seismic Provisions for Structural Steel Buildings.
- B. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 - 3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 6. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 7. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 8. ASTM F436 - Standard Specification for Hardened Steel Washers.
 - 9. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Steel Joist Institute:
 - 1. SJI K - Standard Specifications for Open Web Steel Joists, K-series.
 - 2. SJI LH/DLH - Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.

3. SJI JG - Standard Specification for Joist Girders.

- E. SSPC: The Society for Protective Coatings:
 1. SSPC - Steel Structures Painting Manual.
 2. SSPC SP 1 - Solvent Cleaning.
 3. SSPC SP 10 - Near-White Blast Cleaning.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings:
 1. Indicate standard designations, configuration, sizes, spacing, locations of joists, joist leg extensions.
 2. Joist coding, bridging, connections, attachments.
 3. Connection details.
 4. Cambers
- C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 1. Steel Joist Institute.

1.5 QUALIFICATIONS

- A. Design connections not detailed on drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactures: to be certified by SJI
 1. Vulcraft Steel Joist
 2. SEYCO Joist Company
 3. Or approved equal

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- B. Open Web Joists Members: SJI Type K. LH Longspan. DLH Deep Longspan and joist Girders.
- C. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Unfinished
- D. Washers: ASTM F436; Type 1
 - 1. Finish: Unfinished
- E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

2.2 FABRICATION

- A. Furnish bottom and top chord extensions as indicated on drawings.
- B. Fabricate to achieves minimum end bearing of:
 - 1. 2-1/2 inches on steel.
 - 2. 4 inches on masonry.

2.3 FINISH

- A. Shop prime joists and supplementary framing members. Do not prime surfaces that will be fireproofed.
- B. Prepare joist component surfaces in accordance with SSPC SP 2.

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Furnish shop testing and analysis of steel sections.
- B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.

3.2 ERECTION

- A. Erect and bear joists on supports.
- B. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.
- C. Coordinate placement of anchors in masonry construction for securing bearing plates.
- D. After joist alignment and installation of framing, field weld joist seat to bearing plates or angles.
- E. Position and field weld joist chord extensions and wall attachments as detailed.
- F. Frame floor and roof openings greater than 18 inches with supplementary framing.
- G. Do not permit erection of decking until joists are bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- H. Do not field cut or alter structural members without approval of Architect/Engineer.
- I. After erection, prime welds, abrasions, and surfaces not shop primed

3.3 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: ¼ inch.
- C. Maximum Offset From Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspect members, connections, welds, and tightening of high strength bolts in slip-critical connections.

END OF SECTION

SECTION 05 31 23

STEEL ROOF DECK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel roof deck and accessories.
 - 2. Bearing plates and angles.
- B. Related Sections:
 - 1. Section 033000 - Cast-in-Place Concrete.
 - 2. Section 035216 – Lightweight Insulating Concrete.
 - 3. Section 051200 - Structural Steel.
 - 4. Section 052100 - Steel Joists.

1.2 REFERENCES

- A. American Society of Civil Engineers:
 - 1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.
- B. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Steel Deck Institute:
 - 1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.
- E. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 15 - Steel Joist Shop Paint.

1.3 PERFORMANCE REQUIREMENTS

- A. Design metal deck in accordance with SDI 29 Design Manual and ASCE 3.

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- B. Calculate to structural working stress design and maximum vertical deck deflection of 1/240.
- C. Design deck with maximum lateral diaphragm deflection of 1/500 of story height.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate deck plan, support locations, Projections, openings and reinforcement, pertinent details, and accessories.
- C. Product Data: Submit deck profile characteristics and dimensions, structural properties, and finishes
- D. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions.
- E. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASCE 3 for composite decks.

1.6 QUALIFICATIONS

- A. Design deck layout, spans, fastening, and joints under direct supervision of Professional Engineer experienced in design of this Work and licensed. In State of Texas.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Cut plastic wrap to encourage ventilation.
- C. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sheet Steel: ASTM A653, Grade 33 Structural Quality; with G90 galvanized coating conforming to ASTM A525.

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B. Bearing Plates or Angles: ASTM A36 steel.

C. Welding Materials: AWS D1.1.

2.2 FABRICATION

A. Metal Deck: Sheet steel, configured as follows:

1. Span Design: multiple
2. Minimum Metal Thickness Excluding Finish: 22 gage.
3. Minimum Allowable Diaphragm Shear: 250 plf.
4. Nominal Height: 1-1/2 inch
5. Side Joints: lapped

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 013000 - Administrative Requirements: Coordination and project conditions.

3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Manual.
- B. Bear deck on steel supports with 1-1/2 3 inch minimum bearing. Align and level.
- C. Fasten ribbed deck to steel support members at ends and intermediate supports with as indicated on drawings.
- D. Weld in accordance with AWS D1.1.
- E. Seal deck joints, laps, ends, and penetrations with sealant to achieve permanent air seal consistent with air barrier system specified in Section 07270.
- F. Reinforce steel deck openings from 6 to 18 inches in size with 2 x 2 x 1/4 inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- G. Install wet concrete stops at roof edge upturned to top surface of slab to contain wet concrete. Install stops of sufficient strength to remain stationary under wet concrete without distortion.
- H. Install sheet steel closures and angle flashings to close openings between deck and walls, columns, and openings.
- I. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

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- J. Place metal cant strips in position and mechanically attach.
- K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

3.3 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

SECTION 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 gauge 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.
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.
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.
2. Set work accurately in location, alignment, and elevations, and make plumb, level, true, and free from rack, measured from established lines and levels.

SECTION 05500
METAL FABRICATIONS

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 05720
ALUMINUM HANDRAILS

PART 1 - GENERAL:

1.01 SCOPE:

- A. Perform all work required to complete the ALUMINUM HANDRAILS 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 handrails 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. Julius Blum & Company, Inc.
Tubular Specialisties Mfg.
R & B Wagner, Inc.

2.02 MATERIALS:

- A. "CONNECTOR RAIL SYSTEM" by Julius Blum & Co. or approved equal for a complete installation.
- B. FINISH: Shall be aluminum clear anodized schedule 40 for all handrails 1 ½" outside diameter. Clear anodized schedule 40.
- C. POSTS & RAILS: At o.c. clear anodized with required connection assemblies.
- D. CORNER BENDS: At landings manufacture recommended.
- E. FLOOR FLANG: Aluminum finish with required charge as per mfg. recommendation.
- F. ANCHORS: Provide all fasteners and anchorage for a complete installation.

PART 3: EXECUTION:

3.01 INSTALLATION:

- A. Install in exact accordance with the manufacturer's latest published recommendations, requirements, specifications, details, etc. Installation shall comply with Texas Department of Licensing and Regulations.

END OF SECTION

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

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:

ITEM:

DESCRIPTION:

SECTION 06010
LUMBER

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 |
| 4. ROOFING | SECTION 07535 |

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 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes structural floor, wall, and roof framing; built-up structural beams and columns; diaphragm trusses fabricated on site; floor, wall, and roof sheathing; preservative treatment of wood; fire retardant treatment of wood; miscellaneous framing and sheathing.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A135.4 - Basic Hardboard.
 - 2. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. American Wood-Preservers' Association:
 - 1. AWWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
 - 2. AWWPA C20 - Structural Lumber - Fire-Retardant Treatment by Pressure Processes.
- C. ASTM International:
 - 1. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 2. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing.
 - 3. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
 - 4. ASTM D5456 - Standard Specification for Evaluation of Structural Composite Lumber Products.
 - 5. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 8. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

HIDALGO COUNTY PRECINCT No. 4
NEW JUSTICE CENTER
EDINBURG, TEXAS

- E. U. S Department of Commerce National Institute of Standards and Technology:
 - 1. DOC PS 1 - Construction and Industrial Plywood.
 - 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
 - 3. DOC PS 20 - American Softwood Lumber Standard.
- F. National Lumber Grades Authority:
 - 1. NLGA - Standard Grading Rules for Canadian Lumber.
- G. Northeastern Lumber Manufacturers Association:
 - 1. NELMA - Standard Grading Rules for Northeastern Lumber.
- H. The Redwood Inspection Service:
 - 1. RIS - Standard Specifications for Grades of California Redwood Lumber.
- I. Southern Pine Inspection Bureau:
 - 1. SPIB - Standard Grading Rules for Southern Pine Lumber.
- J. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- K. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.
- L. Western Wood Products Association:
 - 1. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings For Site Fabricated Truss Frame: Indicate dimensions, wood species and grades, component profiles, drilled holes, fasteners, connectors, erection details and sequence.
- C. Product Data: Submit technical data on insulated sheathing, wood preservative materials, and application instructions.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Lumber Grading Agency: Certified by DOC PS 20.
 - 2. Wood Structural Panel Grading Agency: Certified by EWA - The Engineered Wood Association.
 - 3. Lumber: DOC PS 20.
 - 4. Wood Structural Panels: DOC PS 1 or DOC PS 2.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect trusses from warping or other distortion by stacking in vertical position, braced to resist movement.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Lumber Grading Rules: American Softwood Lumber Standard DOC PS 20
- B. Beam Framing: SPF species, No. 2 grade, 19 percent maximum moisture content.
- C. Joist Framing: SPF species, No. 2 grade, 19 percent maximum moisture content.
- D. Rafter Framing: SPF species, No. 2 grade, 19 percent maximum moisture content.

2.2 SHEATHING MATERIALS

- A. Wood Structural Panel Roof Sheathing: EWA Rated Sheathing, Structural I, Plywood, Span Rating 48/24; Exposure Durability 1 or Exterior
- B. Wood Structural Panel Wall Sheathing: EWA Rated Sheathing, Structural I, Plywood, Span Rating 48/24; Exposure Durability 1 or Exterior
- C. Wood Structural Panel Floor Sheathing: EWA Rated Sheathing, Structural I, Plywood, Span Rating 48/24

2.3 UNDERLAYMENT MATERIALS

- A. Plywood Underlayment: EWA Structural I

2.4 SHEATHING AND UNDERLAYMENT LOCATIONS

- A. Sloped Roof Sheathing: 5/8 inch thick, Span Rating 48/24, 48 x 96 inch sized sheets, square edges.
- B. Flat Roof Sheathing: 5/8 inch thick, Span Rating 48/24, 48 x 96 inch sized sheets, square edges.
- C. Floor Sheathing: 3/4 inch thick, Span Rating 48/24, 48 x 96 inch sized sheets, tongue and groove edges.

2.5 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - 2. Nails and Staples: ASTM F1667.
- B. Structural Framing Connectors: Hot dipped galvanized steel, sized to suit framing conditions, manufactured by Simpson Strong Tie or equivalent.

2.6 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWWA Treatment C1 using water borne preservative with 0.25 percent retainage.
- B. Moisture Content After Treatment:
 - 1. Lumber: Maximum 19 percent.
 - 2. Structural Panels: Maximum 15 percent.

PART 3 EXECUTION

3.1 FRAMING

- A. Set structural members level and plumb, in correct position.
- B. Fasten framing in accordance with applicable code.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- D. Place horizontal members, crown side up.
- E. Construct load bearing framing members full length without splices.
- F. Double members at openings over 24 inches wide. Space short studs over and under opening to stud spacing.
- G. Construct double joist headers at floor and ceiling openings and under wall stud partitions parallel to floor joists. Frame rigidly into joists.
- H. Bridge framing in excess of 8 feet in span at mid-span. Fit solid blocking at ends of members.

- I. Coordinate installation of wood decking, wood chord metal joists, glue laminated structural units, prefabricated wood trusses, and wood “T” joists.

3.2 SHEATHING

- A. Fasten sheathing in accordance with applicable code.
- B. Secure roof sheathing with longer edge (strength axis) perpendicular to framing members and with ends staggered and sheet ends over bearing.
- C. Use sheathing clips between sheets between roof framing members.
- D. Secure wall sheathing with long dimension parallel to wall studs, with ends over firm bearing.

3.3 FIREBLOCKING AND DRAFTSTOPPING

- A. Install fireblocking to cut off concealed draft openings.
 - 1. Concealed Framed Wall and Furred Spaces: Install fireblocking vertically at floor and ceiling levels and horizontally at maximum 10 feet on center.
 - 2. Connections Between Horizontal and Vertical Spaces: Install fireblocking between vertical walls and partitions and the following:
 - a. Horizontal floor and roof framing.
 - b. Soffits, dropped ceilings, cove ceilings and other horizontal concealed spaces.
 - 3. Stairs: Install fireblocking between stair stringers at top and bottom of each run.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Framing Members: 1/4 inch from indicated position, maximum.
- C. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch in 30 feet maximum.

END OF SECTION

SECTION 06 15 00

WOOD DECKING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes [softwood lumber] [plywood] [glue laminated] structural wood decking and preservative treatment of wood.

1.2 REFERENCES

- A. APA/Engineered Wood Association:
 - 1. APA -Rated Sheathing.
- B. American Wood Preservers Association:
 - 1. AWPAC1 -All Timber Products Preservative Treatment by Pressure Process.
 - 2. AWPAC20 -Structural Lumber Fire Retardant Treatment by Pressure Process.

1.3 SYSTEM DESCRIPTION

- A. Design roof live and dead load: LL= 20 psf and DL= 10 psf with deflection limited to 1/240 32/16 of span.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate deck framing system, loads and cambers, bearing details, and framed openings.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Lumber Grading Agency: Certified by DOC PS 20.
 - 2. Wood Structural Panel Grading Agency: Certified by EWA -The Engineered Wood Association.
 - 3. Lumber: DOC PS 20.
 - 4. Wood Structural Panels: DOC PS 1

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and certified by AITC.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Georgia Pacific Corp.
 - 2. Louisiana-Pacific Corp.

2.2 MATERIALS

- A. Plywood: APA/EWA[Rated Sheathing , Span Rating 32/16

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify support framing is ready to receive decking.

3.2 PREPARATION

- A. Coordinate placement of bearing items.

3.3 INSTALLATION -PLYWOOD DECKING

- A. Install decking perpendicular to framing members, with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- B. Engage plywood tongue and groove edges.
- C. Allow expansion space at edges and ends.
- D. Attach decking with 8d nails.
- E. Use sheathing clips at unsupported edges of plywood between supporting framing members.
- F. Cut decking to accommodate roof drain and flange.

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 supplied 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, OR PIVOT: Equidistant between the top and 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 the devices. Insofar as practicable, doors opening to or

SECTION 06200
FINISH CARPENTRY

- 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.
- G. All millwork shall conform to the AMERICAN WOODWORK INSTITUTE.

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ARCHITECTURAL WOODWORK

- 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 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. Exterior Walls
 2. Sound 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, John Manville Fiberglass, or an equal approved in advance by the Architect.
- B. EXTERIOR WALL INSULATION: Exterior metal stud walls insulation shall be R-19-6 ½" or R-13-3 ½" thick Eco Touch FSK foil face.
- C. 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" where required for 6" thick walls "Sound Attenuation Batts" unfaced batts, 16" in net width x full height of partition.
- D. CEILINGS: Where shown on drawings. Provide R-38 – 10 ¼" above suspended ceilings, Fiberglass foiled faced insulation by John Manville.
- E. FIREWALLS & NON-FIRE RATED WALLS: Provide and install on top of walls 1" to 4" thick as required SAFING INSULATION by IIG Mineral Wool 1200 safing or equal, to be installed at fire rated walls where fire rating runs to the bottom of roof or floor deck assemblies. Same application for non-fire rated walls. Where indicated on drawings and fire protection plan.

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:
 - 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 CW-25 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. 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 dabs of adhesive spaced approximately 12" o.c. both ways on inside face of insulation board.
- B. Butter all edges between insulation board and over all joints 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 with sealant.

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 $\frac{1}{4}$ 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 $\frac{1}{4}$ 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 $\frac{1}{2}$ " thickness to achieve R value specified. Top layer cover board shall be minimum $\frac{1}{2}$ " 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 07272
FLUID-APPLIED WEATHER BARRIERS FOR MASONRY WALLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fluid-applied, vapor permeable weather barrier membrane. (*DuPont™ Tyvek® Fluid Applied WB System.*)
- B. Joint Treatment:
 - 1. Joint Tape.
 - 2. Joint Compound. (*DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound, trowel grade*)
- C. Flashing:
 - 1. Vapor Permeable Fluid-Applied Elastomeric Flashing. (*DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound or DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade, as manufactured by DuPont™*)
 - 2. Flexible Flashing. (*DuPont™ FlexWrap™NF*)
 - ~~D.~~ Sheet Flashing. (*DuPont™ StraightFlash™*)
 - 3.
 - ~~D.~~ 4. Sealant. (*DuPont™ Sealant for Tyvek® Fluid Applied Systems*)
- ~~E.~~ D. Primers for flexible flashing and sheet flashing.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM C 1250 – Standard Test Method for Nonvolatile Content of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
 - 2. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 3. ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness.
 - 4. ASTM D 4541 – Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.
 - 5. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM E 96 - Test Method for Water Vapor Transmission of Materials
 - 7. ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
 - 8. ASTM E 331 – Standard Test Method for Water Penetration of Exterior Windows, Skylight, Doors and Curtain Walls by Uniform Static Air Pressure Differences.
 - 9. ASTM E 779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
 - 10. ASTM E 783 – Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
 - 11. ASTM E 1105 – Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
 - 12. ASTM E 1186 – Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
 - 13. ASTM E 1677 - Specification for Air Retarder Material or System for Framed Building Walls.
 - 14. ASTM E 2178 – Standard Test Method for Air Permeance of Building Materials
 - 15. ASTM E 2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

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16. ASTM G155 – Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
 17. ASTM C 1305 - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane.
- B. AATCC – American Association of Textile Chemists & Colorists
1. Test Method 127 Water Resistance: Hydrostatic Pressure Test.
- C. TAPPI
1. Test Method T-460; Air Resistance of Paper (Gurley Hill Method).
- 1.3 SUBMITTALS
- A. Refer to Section 01300 Submittal Procedures.
- B. Product Data: Submit manufacturer’s current technical literature for each component.
- C. Quality Assurance Submittals:
1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 2. Manufacturer Instructions: Provide manufacturer’s written installation instructions.
 3. Manufacturer’s Field Service Reports: Provide site reports from authorized field service representative, indicating observation of weather barrier system installation.
- D. Closeout Submittals:
1. Refer to Section 01700 Closeout Submittals.
 2. Weather Barrier Warranty: Manufacturer’s executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.
- 1.4 QUALITY ASSURANCE
- A. Qualifications:
1. Installer shall have experience with installation of commercial fluid-applied weather barrier assemblies under similar conditions.
 2. Installer shall be trained and certified for installation by manufacturer.
- B. Installation shall be in accordance with manufacturer’s installation guidelines and recommendations.
- C. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.
- D. Mock-up:
1. Install mock-up using approved weather barrier system including membrane, flashing, joint and detailing compound and related weather barrier accessories according to weather barrier manufacturer’s current printed instructions and recommendations.
 - a. Mock-up size: 10 feet by 10 feet.
 - b. Mock-up Substrate: Match wall assembly construction, including window opening.

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- c. Mock-up may not remain as part of the work.
 - 2. Contact manufacturer's designated representative prior to weather barrier system installation, to perform required mock-up visual inspection and analysis as required for warranty.
- E. Pre-installation Meeting
- 1. Refer to Section 01200 Project Meetings.
 - 2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Architect, certified installer, Owner's Representative, and weather barrier manufacturer's designated field representative.
 - 3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier system materials and components, installer's training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 Product Requirements.
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by manufacturer.

1.6 SCHEDULING

- A. Review requirements for sequencing of installation of weather barrier system with installation of windows, doors, louvers and flashings to provide a weather-tight barrier system.
- B. Schedule installation of exterior cladding within nine months of weather barrier system installation.

1.7 WARRANTY

- A. Refer to Section 01740 Warranties.
- B. Limited Warranty
 - 1. Manufacturer's warranty for weather barrier for a period of ten (10) years from date of Purchase.
 - 2. Pre-installation meeting and jobsite observations by weather barrier manufacturer for warranty are required.

PART 2 - PRODUCTS

2.1 WEATHER BARRIER

- A. Manufacturer: DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1.800.44TYVEK (8-9835); <http://weatherization.tyvek.com>

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1. Description: A single-component, low VOC, 25 mil thick synthetic polymer fluid-applied product with superior elasticity and flexibility providing resistance to air flow, bulk water and wind driven rain yet allows moisture vapor to escape.
2. Basis of Design: DuPont™ Tyvek® Fluid Applied WB System; including DuPont™ Tyvek® Fluid Applied WB, DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound, DuPont™ Tyvek® Fluid Applied Flashing – Brush Grade and DuPont™ Sealant for Tyvek® Fluid Applied Systems.

B. Performance Characteristics:

1. Air Penetration Resistance (Material):
 - a. 0.0002 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2178.
 - b. Air infiltration greater than 10,000 seconds per 100cc, when tested in accordance with TAPPI Test Method T-460.
2. Air Penetration Resistance (System / Assembly):
 - a. ≤ 0.01 cfm/ft² at 75 Pa, when tested in accordance with ASTM E 2357.
 - b. ≤ 0.01 cfm/ft² at 75 Pa, Type I Air Barrier, when tested in accordance with ASTM E 1677.
3. Water Vapor Transmission: 25 perms, when tested in accordance with ASTM E 96, Method B at 25 mils DFT (Dry Film Thickness).
4. Water Penetration Resistance: Greater than 1000 cm when tested in accordance with AATCC Test Method 127. No leakage at 15 psf when tested in accordance with ASTM E 331.
5. Tensile Strength: Minimum 169 lbs/in², when tested in accordance with ASTM D 412.
6. Estimated Elongation: 420% in accordance with ASTM D 412.
7. Hardness: Passes at a Shore A hardness of 71, when tested in accordance with ASTM D 2240.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 25, Smoke Developed: 25.
9. UV Resistance: 9 months
10. Volatile Organic Content (VOC): Less than 2% (25-30 g/L) when measured in accordance with ASTM C 1250.
11. Adhesion Strength (Concrete): Greater than 33 psi when measured in accordance with ASTM D 4541.
12. Low Temperature Crack Bridging: Pass, when tested in accordance with ASTM C 1305.

2.2 ACCESSORIES

A. Joint Treatment:

1. Joint Tape:
 - a. Product: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.
2. Joint Compound: Fluid-applied, vapor permeable, elastomeric flashing material; trowel applied.
 - a. Product: DuPont™ Tyvek® Fluid Applied Flashing and Joint Compound

B. Flashing:

1. Vapor permeable fluid-applied elastomeric flashing:
 - a. Product: DuPont™ Tyvek® Flashing and Joint Compound.
2. Flexible flashing with butyl adhesive layer.
 - a. Product: DuPont™ FlexWrap™ NF.

And/or

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- 3. Sheet flashing with butyl adhesive layer.
 - a. Product: DuPont™ StraightFlash™.
- C. Sealant: Elastomeric; non-vapor permeable sealant; compatible with weather barrier.
 - 1. Product: DuPont™ Sealant for Tyvek® Fluid Applied Systems.
- D. Primers for flexible flashing and sheet flashing:
 - 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
 - 2. Products:
 - a. DuPont™ Adhesive/Primer
 - b. Denso Butyl Spray

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.2 PREPARATION

- A. Complete surface preparation, priming, flashing and detailing of openings, cracks, and material transitions prior to beginning installation of fluid-applied weather barrier system.
- B. Surfaces shall be clean and free of frost, oil, grease, mold and efflorescence prior to application of fluid-applied weather barrier system.

3.3 INSTALLATION - DETAILING

- A. Corners: Apply fluid-applied joint compound, 25 mil thick, to outside and inside corners. Joint compound shall extend 2 inches from corner for full height of corner] or [Apply primer to outside and inside corners, extend 2 inches on each side of corner. Center sheet flashing over corner and press firmly in place per manufacturer's recommendations.
- B. Joint treatment:
 - 1. Non-movement joints in masonry and transitions to columns and beams:
 - a. Joints 1/4 inch wide or less: Apply fluid-applied joint compound a minimum of 2 inches wide by 60 mils thick to each side of joint or crack.
 - b. Joints 1/4 to 1/2 inch: Apply joint tape to joint, then apply joint compound to joint 2 inches wide by 60 mils thick.] or [Apply primer 2 inches on each side of joint. Center sheet flashing over joint and press firmly in place per manufacturer's recommendations.

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- C. Apply fluid-applied joint compound to cladding anchors prior to installation of weather barrier membrane per manufacturer's instructions.
- D. Apply fluid-applied joint compound around penetrations in exterior walls forming a fillet bead minimum ½ inch onto each surface.
- E. Installation – Vapor permeable fluid-applied elastomeric flashing at openings:
 - 1. At jambs and head of rough opening: Apply 25 mil thickness of fluid-applied flashing to full depth of opening and 2 inches onto outside face of opening.
 - 2. At sills: Apply primer to substrates as recommended by manufacturer. Cut sheet flashing to fit directly between jambs of opening. Install sheet flashing to full width of sill opening and down onto outside face of opening a minimum of 2 inches. Cover sheet flashing with 25 mil thickness of vapor permeable fluid-applied elastomeric flashing per fluid-applied weather barrier manufacturer's instructions.

OR

- F. Installation – Self-adhered flexible and sheet flashing at openings:
 - 1. Prime substrates as recommended by self-adhered sheet membrane flashing manufacturer. Cut flexible flashing a minimum of 12 inches longer than length of sill rough opening.
 - 2. Cover horizontal sill by aligning flexible flashing so that 2 inches will extend onto the face of the wall. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure sheet membrane tightly into corners by working in along the sill before adhering up the jambs.
 - 3. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place.
 - 4. Apply 9-inch wide strips of sheet flashing at jambs. Align sheet flashing so that 2 inches will extend onto the face of the wall. Start sheet flashing at head of opening and lap sheet membrane at sill.
 - 5. Install flexible flashing at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
 - 6. Coordinate flashing with fluid-applied weather barrier and window installation.
- G. Allow Fluid-Applied Flashing, Joint Compound and Sealant to cure for minimum 24 hours before coating with Fluid-applied Weather Barrier.

3.4 INSTALLATION - FLUID-APPLIED WEATHER BARRIER

- A. Install fluid-applied weather barrier prior to installation of windows, doors, and louvers.
- B. Mask and protect any adjacent finished surfaces from fluid-applied weather barrier material.
- C. Install fluid-applied weather barrier over exterior face of required exterior wall substrates in accordance with weather barrier manufacturer recommendations and instructions.
- D. Install fluid-applied weather barrier by power-rolling method or hand rolling to achieve 25 mils providing a consistent and uniform thickness.
- E. Repair any voids, holidays, or non-uniform installations or damage by other trades to proper mil thickness prior to installation of final cladding assemblies.

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3.5 FIELD QUALITY CONTROL

- A. Notify weather barrier manufacturer's designated representative to obtain required periodic observations of weather barrier system installation.
- B. Weather barriers assemblies will be considered defective upon failure of inspections and specific project testing required.
 - 1. Apply additional fluid-applied weather barrier material, in accordance with manufacturer's instructions, where inspection results indicate insufficient thickness, voids, skips, pinholes or other defects as recommended by weather barrier manufacturer.
 - 2. Remove and replace deficient weather barrier system components for retesting as specified above.
- C. Repair damage to weather barriers caused by destructive testing; follow manufacturer's written instructions.

3.6 PROTECTION AND CLEANING

- A. Protect weather barrier from contact with incompatible materials and sealants not approved per weather barrier manufacturer's recommendation.
- B. Protect installed weather barrier system from damage during construction prior to cladding installation.
 - 1. If damaged or exposed to UV beyond nine (9) months, clean and prepare surfaces and install additional, full-thickness, fluid-applied weather barrier application in accordance with weather barrier manufacturer's instructions.
- C. Remove masking materials and adjacent protection after weather barrier installation.

END OF SECTION

SECTION 07415
MANUFACTURED METAL PANELS

PART 1: GENERAL

1.01 SUMMARY:

- A. Performed Metal Wall panel system for application to roof-side surface of parapet walls.
- B. Preformed metal soffit panels at standing seam roof soffits.

1.02 RELATED SECTIONS:

- A. Section 06110 - Rough Carpentry for Roofing
- B. Section 07220 - Roof Insulation
- C. Section 07610 - Pre-formed Metal Roofing
- D. Section 07600 - Flashing and Sheet Metal

1.03 REFERENCES:

- A. American Society for Testing and Materials:
 - 1. ASTM A153 - Zinc Coating (hot Dip) or Iron Steel Hardware.
 - 2. ASTM A 446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, Structural (Physical) Quality.
- B. American Society of Civil Engineers:
 - 1. ASCE 7-95-Minimum Design Loads for Buildings and Other Structures

1.04 SYSTEM DESCRIPTION:

- A. Site assembled, preformed, prefinished metal wall and soffit panel systems.
- B. Performance Requirements: Size Components as indicated on drawings and as required to withstand dead and live loads due to positive and negative wind pressure acting normal to the plane of the respective panel system as calculated in accordance ASCE 7-95.
- C. Panel systems shall be installed to allow for and accommodate thermal expansion and contraction resulting from seasonal temperature differences.

1.05 SUBMITTALS:

- A. Product Data: Provide data describing physical and performance characteristics and limitations including span tables; component profiles, fastening methods, joint detailing, and accessories; standard sizes, surface.
- B. Shop Drawings: Provide complete system drawings, including fully dimensioned panel layout, construction details, means of anchorage, method and sequence of installation, locations and size of shop cut openings, and type of closures, trim and fittings.

- C. Samples:
 - 1. Submit color chart of all pre-finished and/or galvalume metal to be used.
 - 2. Submit 12" x 12" sized illustrating selected profile, surface texture and color.
- D. Installers Certificate: Certifying that products and systems have been installed according to manufacturer's installation instructions and applicable codes and ordinances.
- E. Manufacturer's Installation Instructions: include installation sequence, special instructions and Material Safety Data Sheets.
- F. Manufacturer's Certificate: Certificate stating products meet all specified requirements and that systems have been designed according to applicable codes and ordinances.
- G. Maintenance Data: Manufacturer's written recommendations for cleaning agents and cleaning methods to be used, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance
- H. Contract Closeout Submittals:
 - 1. Project Record Documents.
 - 2. Contractors Five Year Labor and Material Warranty.
 - 3. Manufacturers Twenty Year Finish Warranty.

1.06 QUALITY CONTROL:

- A. Work of this Section shall conform to these specifications, and to the written specifications or installation instructions of the approved panel manufacturer. Where discrepancies may arise the more stringent requirement will govern.
- B. Qualifications for Work of this Section:
 - 1. Manufacturer specializing in the manufacture of products in this Section with a minimum of three (3) years documented experience; approved by the Manufacturer.
- C. Pre-Installation Conference:
 - 1. Convene a roofing pre-installation conference two weeks prior to commencing work of this Section, under provisions of applicable Section.
 - 2. Require attendance of parties directly affecting Work of this Section.
 - 3. Review conditions of demolition, if applicable, installation, installation procedures and coordination with related Work.

1.07 DELIVERY, STORAGE AND HANDLING:

- A. Deliver products to the site and store/protect on site under provisions of applicable Section.
- B. Deliver products in manufacturer's original containers, dry, undamaged, with seal and labels in tact. Include test report data.

1.08 SEQUENCING AND SCHEDULING:

- A. Coordinate work under provisions of applicable Section.
- B. Coordinate installation of associated metal flashing and roof related items as Work of this Section proceeds.

1.09 WARRANTY:

- A. Provide five (5) year warranty from installing Contractor covering damage to building resulting from failure to resist penetration of water and replacement of defective materials and labor.
- B. Manufacturer's Warranty: Provide a twenty year finish warranty for roof panel and trim materials manufacturer covering the pre-finished against fade, chalking, flaking and the like.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Metal Panel System:
 - 1. AEP Span
 - 2. MBCI
- B. Substitutions: Provide all applicable data for proposed substitution no less than ten days prior to bid due date for review and addendum purposes.

2.02 MATERIALS

- A. Metal Wall Panel System:
 - 1. 24 gauge, pre-finished galvanized sheet steel, exposed fastener wall panel system. Finish shall be equivalent to Kynar 500 baked enamel finish from panel manufacturer's standard colors as selected by the Owner's Representative.
 - 2. Panel Profile:
 - a. MBCI - R-Panel.
- B. Metal Soffit Panel System:
 - 1. 24 gauge, pre-finished galvanized sheet steel, concealed fastener soffit panel system. Finish shall be equivalent to Kynar 500 baked enamel finish from manufacturer's standard colors as selected by the Owner Representative.
 - 2. Panel Profile:
 - a. AEP Span - Flush Panel
- C. Bituminous Materials:
 - 1. Felt Underlayment: 30# Asphalt Saturated Felt Underlayment.
- D. Accessories:
 - 1. Mechanical Fasteners: #10 (min) self-tapping stainless steel sheet metal screws. Exposed fasteners to be equipped with hex washer head and sealing neoprene washer. Exposed heads to be factory color coated to match color of wall panel.
 - 2. Furring Channels: 20 gage, 7/8 x 2-3/4" hat section, G-60 galvanized steel.
 - 3. Contour Closures: Waterproof, all weather type, cured resilient without final set.
 - 4. Touch Up Paint: As supplied from and by the manufacturer to match finish.
 - 5. Substitutions: Under Provisions of applicable Section.

PART 3 EXECUTION

3.01 EXAMINATION:

- A. Verify that surfaces and site conditions are ready to receive the Work of this Section.
- B. Verify that surface to receive Work is supported and secured.
- C. Verify that surface to receive metal paneling is clean and smooth, free of depressions, waves, or other projections that may mar or otherwise detract from the finished appearance.
- D. Take site dimensions affecting Work of this Section.
- E. Report any discrepancies to the Construction Manager or his representative in writing.
- F. Beginning of installation means installer accepts existing surfaces.

3.02 FABRICATION:

- A. Panels: Minimum 24 gage thick sheet stock (heavier gages as necessary for span and conditions encountered).
- B. Internal and External Corners: Same matching sheet materials; thickness and finish to match panel; profile to suit system and seams as encountered; brake formed, shop cut and factory mitered to required edges, angles and tolerances.
- C. Expansion and Control Joints: Same materials and finish as panels; 24 gage; manufacturer's standard brake formed type of profile to suit system.
- D. Trim, Closure Pieces, Caps and Fascias: Same material, thickness and finish as sheet and panel stock; brake formed to required profiles.
- E. Anchorage and Support Members: As dictated by manufacturer to meet specified wind uplift resistance, for specific system approved for installation.

3.03 UNDERLAYMENT APPLICATION:

- A. Ensure all surfaces to receive underlayment are in clean and dry condition.
- B. Ensure roofing counterflashing receiver metal is in place prior to placing wall panel underlayment.
- C. Install One (1) ply of 30# roofing felt underlayment to entire surface of plywood sheathing designated to receive metal wall panel. Lay felt horizontally beginning at bottom edge of wall lapping bottom of underlayment over counterflashing receiver metal and sill flashing trim. Lap succeeding sheets 2 in. over preceding sheet so as not to obstruct the flow of water.

3.04 METAL PANEL SYSTEM APPLICATION:

- A. Install metal panel system in accordance with approved manufacturer's written instructions.
- B. Install closures, trim and accessories meeting all manufacturer's specifications and requirements to achieve complete water-tight metal roof assembly.
- C. Protect surfaces in contact with cementitious materials and dissimilar metal with bituminous paint. Allow to dry prior to installation.

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MANUFACTURED METAL PANELS

- D. All fastening of panel systems, cleats, accessories and the like shall be aligned with structure, level and plumb within specified tolerances. Provide expansion and control joints where required and reduce oil canning or stress.
- E. Remove site cuttings from finish surfaces.

3.05 FIELD QUALITY CONTROL:

- A. Request site attendance of materials manufacturers during installation of the Work.

3.06 MANUFACTURERS FIELD SERVICES:

- A. Request site attendance of materials manufacturers during installation of the Work.

3.07 CLEANING:

- A. Remove visible markings from finished areas and surface leaving all exposed surfaces smooth and free of imperfections.
- B. Repair or replace defaced or disfigured finishes caused by Work of this Section.

3.09 PROTECTION:

- A. Protect finished Work under applicable Section.

END OF SECTION

**SECTION 7549
ADHERED MULTI-PLY ROOF SYSTEM**

PART 1 - GENERAL

1.01 AREAS COVERED

- A. Low Sloped Roof Areas.

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.
- B. Manufacturer's Observation Reports: Beginning with the commencement of the roofing system installation for the project and continuing through the completion of the roofing system installation and all its associated components, the Roofing System Manufacturer or their appointed representative shall provide jobsite observations and written observation reports including digital photos as follows and this shall be confirmed in writing by the manufacturer and made part of the roofing submittals.
 - 1. Keep the Architect / Owner informed as to the progress, status, and quality of work as observed.
 - 2. Provide weekly jobsite observations no less than (2) hours per week throughout the installation of the roofing system and its associated components. Reports shall include detailed weekly reports to the Architect and Roofing Contractor along with digital photographs of work in progress. These reports and photographs shall be descriptive of actual work in progress, status, and condition, and be presented in a written format with digital color photographs.
 - 3. Report to the Architect in writing any refusal or failure of the Contractor to correct installations, practices and/or conditions in conflict with the specifications and/or manufacturer's recommended guidelines called to the Contractor's attention.
 - 4. It will be the sole responsibility of each bidder to ensure these conditions are to be met by the roofing system manufacturer and/or their appointed representative prior to bidding.

1.04 MANUFACTURER QUALIFICATIONS

- A. A qualified manufacturer that has been UL Listed and has FM Approvals for membrane roofing system similar to that used 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 bitumen's.
- 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. Shop drawings shall be project specific engineered drawings or CAD. Hand sketches, tracings, or photo copies of project documents are not acceptable. Manufacturer's standard details must be representative of actual job conditions.
- 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 45° 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 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 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. Field roof membrane shall be a white polyester reinforced fleece-backed PVC with Elvaloy® membrane.
- B. Membrane shall have the following minimum physical property values:

<u>Property</u>	<u>Test Method</u>	<u>Specification</u>
Color		White
Thickness	ASTM D751	.067"
Thickness over scrim	ASTM D7635	.030"
Breaking Strength (lbf)	ASTM D751	325 x 324
Tear Strength (lbf)	ASTM D751	89 x 109
Seam Strength (lbf)	ASTM D751	295
Elongation	ASTM D751	50% x 42%
Heat Aging	ASTM D3045	> 90 %
Low Temp. Bend	ASTM D2136	Pass (-40°F)
Static Puncture Resistance	ASTM D5602	Pass
Dynamic Puncture Resistance	ASTM D5635	Pass
Permeance	ASTM E96	0.003 Perms
Dimensional Stability	ASTM D1204	0.3%
Weight change after Water Immersion	ASTM D570	1.20%
Accelerated Weathering	ASTM G155	Pass

Fungi Resistance	ASTM G21	No Growth
Solar Reflectivity	ASTM C1549	82% (White)
	ASTM C1549	69% (Gray)
	ASTM C1549	68% (Tan)
Emissivity	ASTM C1371	.91 (White)
	ASTM C1371	.86 (Gray)
	ASTM C1371	.87 (Tan)
SRI	ASTM E1980	109 (White)
	ASTM E1980	83 (Gray)
	ASTM E1980	83 (Tan)

2.03 FLASHING MEMBRANE

- A. The flashing membrane shall be a white PVC with Elvaloy® polyester reinforced flexible sheet.

<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 D 751	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.
1. Description: Non-reinforced thermoplastic white membrane, thickness approximately 45 mils.
 2. 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>Cap Sheet</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 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.

<u>Properties</u>	
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

- C. Polyether sealant: The joint sealant shall be a 100% solid, one-component, gun grade, non sag, polyether-base material. It shall be applicable for use at Kynar 500 coated metal, in, vertical, and overhead joints. The sealant shall cure under the influence of atmospheric moisture to form an elastomeric joint material. Materials shall comply to: ASTM C920, Type S, Grade NS, Class 50, Use T2, NT, M, A, G, and O; Canadian Specification CAN/CGSB-19.13-M87, Classification MCG-2-25-A-N, No. 81026; DuraLink as manufactured by Chem Link, Inc., or approved equal.

<u>Properties</u>	<u>Results</u>	<u>Test Methods</u>
Tensile strength, psi	250-300	ASTM D412
Peal strength, psi	25-30	ASTM C794
Elongation at break,	% 750-800	ASTM D412
Hardness, Shore A	17-23	ASTM C661
Lap shear Strength, psi 150-175	ASTM D1002	
Low temp. flexibility	Pass-10°F (-23°C)	ASTM D816
1/4inch mandrel		
Service Temperature -	40°F to 200°F (-40°C to 93°C)	

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 minimum two (2) layers of rigid polyisocyanurate foam board; thickness and LTTR-value shall be a minimum of 4.25" = 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-fourth inch (1/4") slope per foot to roof drains 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 adhering membranes to various substrates, produced by Ashland Chemical, or approved equal.

Typical Liquid Properties (Room Temperature)

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 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.
 - 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 POURABLE 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.

2.19 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.

2.20 WALKWAY PAD

- A. The walkway pad shall have the following minimum physical properties, and be applied with edges heat or solvent welded.

<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

2.21 TERMINATION/PRESSURE BARS

- A. Aluminum strip shall be extruded channel bar with a mill finish, width one inch (1"), thickness 0.100" $\pm$.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.

2.22 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.

2.23 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.

2.24 SELF-ADHERING UNDERLAYMENT FOR TEMPORARY WATERPROOFING

- A. A premium heavyweight, minimum 60 mil, self-adhering underlayment, to use as a temporary waterproofing barrier.

2.25 OVERNIGHT SEAL

- A. Hot applied asphalt bitumen shall be provided for the purpose of night sealing the roof system.

2.26 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.

2.27 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

2.28 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 III asphalt shall be 500° F.
 - 11. The temperature of Type III 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.
- B. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners.
- C. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings one-fourth inch (1/4") or larger shall be filled with insulation.
- D. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
- E. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
- F. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required to minimum of NRCA standards.

3.04 MECHANICALLY FASTENED INSULATION

- A. Specified insulation shall be loose laid with specified cover board and 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 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. The second layer of insulation shall be laid over the first using offset joints, so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer.
- C. The top surface of the second layer of insulation and/or tapered insulation shall receive the specified cover board using offset joints so that each layer breaks joints to a minimum of six inches (6") both ways with the preceding layer, and mechanically fastened thru all layers into the metal deck.

3.05 NAILERS

- A. Wooden nailers shall be installed at gravel stops, drip edges, and expansion joints on outside perimeter of building according to NRCA, Underwriters Laboratory and IBC guidelines.
- B. All Construction: Nailers shall be the same height as the new recovery board being installed where required. Nailers shall be raised if necessary, by anchoring an additional nailer of appropriate height to the existing nailer if the existing nailer is not to be replaced. Nailers shall be anchored to resist a pull-out force of one hundred seventy-five pounds (175#) per foot. Fasteners shall be no less than two (2) per nailer and be spaced at three feet (3') on center maximum. Expansion joint nailers shall extend upward a minimum of eight inches (8") above finish roof height.

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. The cover Board shall be covered with SBS 80 mil SS base sheet 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: If ply sheets are to be left exposed to the elements for more than 5 days, the top ply must be glazed coated with a solid mopping of Type IV asphalt at the nominal rate of thirty pounds (30#) per one hundred (100) square feet.

3.08 HOT APPLIED FLEECE BACKED MEMBRANE

- A. Adhered Application: 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 PVC with Elvaloy® flashing membrane.
1. Mechanically fasten flashing at terminations according to approved details.
 2. 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 flashings shall be mechanically fastened with a termination bar a maximum of six inches (6") on center, be a maximum 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. After proper termination of the base flashing at a minimum eight inch (8") height (or maximum eighteen inch (18") height), a counterflashing shall be installed according to NRCA and SMACNA guidelines.
 - H. All vertical flashing lap seams of the flashing membrane shall be hot-air welded.
 - I. 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.
 - J. 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.
 - K. 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. Re-seam voids immediately with a hot-air gun and roller.
 - L. 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 twenty feet (20'). Flashing shall be installed in strict accordance with the manufacturer's recommendations.
 - B. All existing substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
 - C. All substrates receiving welded-seam flashing membrane shall be clean and primed with primer, prior to application when applicable.
 - D. The vertical wall flashing membrane shall be set in flashing bonding adhesive according to manufacturer's guidelines.
 - E. All vertical flashing lap seams of the flashing membrane shall be hot-air welded.
 - F. 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.
 - G. Immediately following the laying of the flashing membrane, it shall be pressed or rolled in the width direction of the membrane. This will prevent excessive entrapment of air beneath the membrane. The pressing or rolling shall be in the width direction and with the laps so as not to buck the laps.

- H. Any flashing extending further than eighteen inches (18") up onto a vertical surface shall be installed using the strapped method and must be fastened with a termination bar or installed up and over the parapet wall and fastened to the nailer on the outside of the wall.
- I. The flashing membrane shall be run up the wall in sheet widths, run under the coping cap and be terminated on the outside of the wall six inches (6") on center; then the coping cap shall be reset. All side laps are to be hot-air welded.
- J. Hot-air Welding 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 the contractor by using two (2) pieces of flashing membrane. Minimum width of hot-air weld shall be two inches (2").
 - 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. Reseam 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.
- L. 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.

3.12 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.

3.13 EDGING FLASHINGS

- A. An NRCA-approved gravel stop/fascia system shall be installed in strict accordance with published instructions to meet ES-1.

3.14 WALKWAY PADS

- A. 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.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 PIPING/CONDUIT

- A. Piping/conduit shall be raised to NRCA recommended heights, and new supports furnished. Permanent supports shall be installed upon pads approved by membrane manufacturer. Coordinate work with Owner's representative.
- B. All gas lines, piping, and conduits shall be coated with industrial grade yellow paint.

3.20 PIPE/EQUIPMENT SUPPORTS

- A. Designated pipe/equipment supports shall be removed and replaced with new pipe supports. Pipe supports shall be placed approximately ten feet (10') on center. New blocks shall be set on a double layer of membrane and attached to the pipe with suitable strapping. Double layer of membrane shall be adhered to the roof surface.
- B. Gas lines three inches (3") and over must be supported on wood block with pipe roll stands.

3.21 OVERNIGHT SEAL

- A. Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual, SPRI and membrane manufacturer's recommended procedure.
- B. The roofing membrane shall be sealed to the roof deck or existing roof at the end of the day or at the onset of inclement weather to prevent water from flowing into the completed roofing system. Temporary seals shall be removed upon resumption of work.

END OF SECTION 07549

SECTION 07620
SHEET METAL AND MISCELLANEOUS ACCESSORIES
FOR 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.
- 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 20-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. Form sheet metal on bending brake.
- D. Form materials with straight lines, sharp angles and smooth curves.
- E. Fold back edges on concealed side of exposed edge to form hem (1/2" minimum).
- F. Weld or solder joints on parts that are to be permanently and rigidly assembled.
- G. Limit single-piece lengths to ten feet (10').
- H. Fabricate corner pieces with eighteen inch (18") extensions, mitered and sealed by forming as one piece.
- I. Where installing flashing directly to masonry or dissimilar materials, backpaint with bituminous paint
- J. 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.
- K. All sheet metal shall be sealed and watertight.
- L. Metal work should be secured so as to prevent damage from buckling or wind. Where clips are shown, these are to be continuous.
- M. All metal to receive bitumen or adhesive shall be first primed with asphalt primer.
- N. All prefinished metal shall be sanded and/or abraded prior to receiving primer.
- O. 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.

- P. 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® cladded metal shall be fabricated as needed; follow these specifications and standard sheet metal practice for attachment to roof details.

C. Edge/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. Back paint 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.
- G. Gutter and Downspout:
1. Fabrication:
 - a) Fabricate gutter and downspout of profile and size indicated.
 - 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 gutter, downspout, and accessories.
 - 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) Gutter: SMACNA style profile; submit detail for approval. Seal all joints, six inches by six inches (6" x 6") minimum.
 - e) Downspouts: Rectangular profile. Seal all joints, six inches by six inches (4" x 6") minimum.
 - f) Support Brackets, Joint Fasteners: Profiled to suit gutters and downspouts.
 - g) Anchorage Devices: SMACNA requirements. Type recommended by fabricator.
 - h) Gutter Support: Kynar.
 - i) Downspout Supports: Straps, Kynar.
- H. Overflow Scupper, Collector Head and Downspout:
1. Fabrication:
 - a) Fabricate overflow scupper, 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.
 - 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.

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 07620

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 7620
SHEET METAL AND MISCELLANEOUS ACCESSORIES
FOR 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.
- 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 20-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. Form sheet metal on bending brake.
- D. Form materials with straight lines, sharp angles and smooth curves.
- E. Fold back edges on concealed side of exposed edge to form hem (1/2" minimum).
- F. Weld or solder joints on parts that are to be permanently and rigidly assembled.
- G. Limit single-piece lengths to ten feet (10').
- H. Fabricate corner pieces with eighteen inch (18") extensions, mitered and sealed by forming as one piece.
- I. Where installing flashing directly to masonry or dissimilar materials, backpaint with bituminous paint
- J. 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.
- K. All sheet metal shall be sealed and watertight.
- L. Metal work should be secured so as to prevent damage from buckling or wind. Where clips are shown, these are to be continuous.
- M. All metal to receive bitumen or adhesive shall be first primed with asphalt primer.
- N. All prefinished metal shall be sanded and/or abraded prior to receiving primer.
- O. 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.
- P. 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/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. Back paint 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.

- G. Gutter and Downspout:
 - 1. Fabrication:
 - a) Fabricate gutter and downspout of profile and size indicated.
 - 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 gutter, downspout, and accessories.
 - 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) Gutter: SMACNA style profile; submit detail for approval. Seal all joints, six inches by six inches (6" x 6") minimum.
 - e) Downspouts: Rectangular profile. Seal all joints, six inches by six inches (4" x 6") minimum.
 - f) Support Brackets, Joint Fasteners: Profiled to suit gutters and downspouts.
 - g) Anchorage Devices: SMACNA requirements. Type recommended by fabricator.
 - h) Gutter Support: Kynar.
 - i) Downspout Supports: Straps, Kynar.

- H. Overflow Scupper, Collector Head and Downspout:
 - 1. Fabrication:
 - a) Fabricate overflow scupper, 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.
 - 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.

- 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 7620

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 07720
ROOF HATCH

PART ONE – GENERAL

1.01 SUMMARY

- A. Work included: Furnishing and installing factory fabricated roof hatches.
- B. Related Work: Division 1 General Requirements.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM), 100 Bar Harbor Drive, West Conshocken, PA 19428-2959; (610) 832-9585, fax (610) 832-9555
 - 1. ASTM A 36-93a: Standard Specification for Structural Steel

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for all materials in this specification.
- B. Shop Drawings: Show profiles, accessories, location, and dimensions.
- C. Samples: Manufacturer to provide upon request; sized to represent material adequately.
- D. Contract Closeout: Roof hatch manufacturer shall provide the manufacturer's Warranty prior to the contract closeout.

1.04 PRODUCT HANDLING

- A. All materials shall be delivered in manufacturer's original packaging.
- B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.
- C. Remove protective wrapping immediately after installation.

1.05 SUBSTITUTIONS

- A. Proposals for substitution products shall be accepted only from bidding contractors and not less than (10) working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.06 JOB CONDITIONS

- A. Verify that other trades with related work are complete before installing roof hatch(s).
- B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.
- C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.
- D. Coordinate installation with roof membrane and roof insulation manufacturer's instructions before starting.
- E. Observe all appropriate OSHA safety guidelines for this work.

1.07 WARRANTY/GUARANTEE

- A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge. Electrical motors, special finishes, and other special equipment (if applicable) shall be warranted separately by the manufacturers of those products.

PART TWO - PRODUCTS

2.01 MANUFACTURER

- A. The BILCO Company, P.O. Box 1203, New Haven, CT 06505,
1-203-934-6363, Fax: 1-203-933-8478, Web: www.bilco.com or approved equal.

2.02 ROOF HATCH

- A. Furnish and install where indicated on plans metal roof hatch **Type F-50T**, size width: 4'0" (1219mm) x length: 4'0" (1219mm). Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
1. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m²) with a maximum deflection of 1/150th of the span or 20 psf (97kg/m²) wind uplift.
 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 3. Operation of the cover shall not be affected by temperature.
 4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.
- C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 4" (102mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be 2" (50mm) thick polyisocyanurate with an R-value of 12, fully covered and protected by an 18 gauge aluminum liner.
- E. Curb: Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. The curb shall be formed with a 4-1/2" (114mm) flange with 7/16" (11.1mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be 2" (50mm) thick polyisocyanurate with an R-value of 12.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
- H. Hardware
1. Heavy pintle hinges shall be provided.
 2. Cover shall be equipped with a spring latch with interior and exterior turn handles.
 3. Roof hatch shall be equipped with interior padlock hasps. **Core to match school district's key system.**
 4. The latch strike shall be a stamped component bolted to the curb assembly.
 5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25.4mm) diameter red vinyl grip handle to permit easy release for closing.
 6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed.

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ROOF HATCH

- 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- I. Finishes: Factory finish shall be mill finish aluminum.
- J. Safety Equipment: Ladder Up LU-1 yellow powder coat.

PART THREE - EXECUTION

3.01 INSPECTION

- A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.02 INSTALLATION

- A. Submit product design drawings for review and approval to the architect or specifier before fabrication.
- B. The installer shall check as-built conditions and verify the manufacturer's roof hatch details for accuracy to fit the application prior to fabrication. The installer shall comply with the roof hatch Manufacturer's installation instructions.
- C. The installer shall furnish mechanical fasteners consistent with the roof requirements.

END OF SECTION

SECTION 07920
JOINT SEALERS FOR METAL WALL PANELS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Polyurethane Sealants B.
- Tape Mastic Sealants C.
- Non-skinning Sealants D.
- Silicone Sealants
- E. Acrylic Sealants

1.2 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA)
 - 1. AAMA 800-10 - Voluntary Specifications and Test Methods for Sealants
- B. ASTM International (ASTM)
 - 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 792 - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM C 639 - Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
 - 4. ASTM C 661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
 - 5. ASTM C 681 - Standard Test Method for Volatility of Oil- and Resin-Based, Knife-Grade, Channel Glazing Compounds
 - 6. ASTM C 711 - Standard Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants
 - 7. ASTM C 794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - 8. ASTM C 908 - Standard Test Method for Yield Strength of Preformed Tape Sealants
 - 9. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
 - 10. ASTM D 56 - Standard Test Method for Flash Point by Tag Closed Cup Tester
 - 11. ASTM D 217 - Standard Test Methods for Cone Penetration of Lubricating Grease
 - 12. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 - 13. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 14. ASTM D 925 - Standard Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)
 - 15. ASTM D 2452 - Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
 - 16. ASTM D 2453 - Standard Test Method for Shrinkage and Tenacity of Oil- and Resin- Base Caulking Compounds
 - 17. ASTM D 1475 - Standard Test Method For Density of Liquid Coatings, Inks, and Related Products
 - 18. ASTM D 2202 - Standard Test Method for Slump of Sealants
 - 19. ASTM D 2203 - Standard Test Method for Staining from Sealants

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- 20. ASTM G 154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
- C. Interim Federal Specifications (FS)
 - 1. FS TT-S-00230C - Sealing Compound: Elastomeric Type, Single Component
 - 2. FS TT-C-1796A – Caulking Compounds, Metal Seam and Wood Seam
 - 3. FS TT-S-001543A – Sealing Compounds: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures)
- D. South Coast Air Quality Management District (SCAQMD)
 - 1. Rule 1168 – Adhesive and Sealant Applications
- E. Underwriter’s Laboratories
 - 1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.3 SUBMITTALS

- A. Material Safety Data Sheets (MSDS): Provide in accordance with 29 CFR 1910.1200, Hazard Communication
- B. Product Test Reports: Reports of tests required by this section performed by a qualified testing agency, indicating that the sealants comply with the requirements.
- C. Buy American Compliance: Provide documentation that the products provided in this section comply with the following requirements:
 - 1. Buy American provisions of Section 1605 of the American Recovery and Reinvestment Act of 2009 (ARRA).
- D. VOC Content: Provide documentation of the Volatile Organic Content (VOC) in accordance with SCAQMD Rule 1168
- E. USDA Approval: Provide documentation that the product is approved for use in meat and poultry processing areas by the USDA for the following types of sealants:
 - 1. Polyurethane
 - 2. Tape Mastic
 - 3. Non-skinning Sealant

1.4 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within 5 years of installation.

PART 2 - PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

- A. Substrate Requirements: When testing is required on a substrate, the material used shall be either ASTM A653 G-90 or ASTM A792 AZ50 and tests shall be conducted with each of the following coatings:
 - 1. Bare (No coating)

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2. Acrylic (Galvalume Plus)
3. Polyester
4. Siliconized Polyester
5. Polyvinylidene Fluoride Resin (PVDF)

2.2 POLYURETHANE SEALANT

- A. General: Provide Sealants that meet the following specifications:
1. ASTM C 920, Type S, Grade NS, Class 25, Use: NT, A, M, G and O paintable sealant
 2. AAMA 808.3
 3. FS TT-S-00230C, Type II, Class A
- B. Color: The sealant shall be in the following colors:
1. White
 2. Gray
 3. Bronze
 4. Almond
- C. Physical Properties: The sealant shall have the following additional physical properties:
1. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 15 lb/in when tested in accordance with ASTM C 794.
 2. Tensile Strength: Sealant shall have a tensile maximum of 300 psi and an elongation of 500-600% when tested in accordance with ASTM D 412.
 3. Sag: There shall be no sag when tested in accordance with ASTM C 639.
 4. Hardness: Shore "A" hardness on all three samples shall not exceed 40 when tested in accordance with ASTM C 661
 5. Service Temperature Range: -40 degrees Fahrenheit to 200 degrees Fahrenheit.
 6. Water Resistance: There shall be no presence of voids, cracks, separation or breakdown of the compound when tested in accordance with AAMA 800-10, Section 2.11.1.
 7. Flash Point: No less than 145 degrees Fahrenheit when tested in accordance with ASTM D 56.
 8. Shelf Life: The compound shall have a shelf life of 9 months or more when stored at or below 80 degrees.
 9. Skin Time: The compound shall have a skin time of 2-4 hours
 10. Cure Time: The compound shall have a cure time of 24-48 hours
 11. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.3 TAPE MASTIC SEALANT

- A. General: Provide Sealants that meet the following specifications:
1. AAMA 804.3
 2. AAMA 807.3
 3. FS TT-C-1796A, Type II, Class B
 4. Approved by Underwriters Laboratories for use in roof deck constructions classified under UL-518 Class 90
- B. Color: Gray
- C. Physical Properties: The sealant shall have the following additional physical properties:
1. Specific Gravity: 1.4 or higher when tested in accordance with ASTM D 792

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2. Tensile Adhesive Strength: 20 psi or higher when tested in accordance with ASTM C 908
3. Elongation: 1000% or higher when tested in accordance with ASTM C 908
4. Cone Penetration: The sealant shall meet the following conditions when tested in accordance with ASTM D 217 with a 300g cone in 5 seconds:
 - a. 8.5 – 100 mm at 77 degrees Fahrenheit
 - b. 125-135 mm at 120 degrees Fahrenheit
 - c. 45-55 mm at Zero degrees Fahrenheit
5. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.4 NON-SKINNING SEALANT

A. General: Provide sealants that meet the following specifications:

1. AAMA 809,2
2. FS TT-C-1796A, Type 1, Class A B.

Color: White

C. Physical Properties: The sealant shall have the following additional physical properties:

1. Extrudability: The sealant shall deposit in 30 to 50 seconds through a 0.104" orifice at 50 psi pressure in accordance with ASTM D 2452
2. Total Solids: At least 85% by weight when determined in accordance with ASTM C 681
3. Volume Shrinkage: Less than 15% when determined in accordance with ASTM D 2453
4. Weight per U.S. Gallon: 10.75 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475
5. Vehicle Bleed out: There shall be no visible exudation of vehicle from sealant after 21 days at 158 degrees Fahrenheit on the test panel
6. Flexibility: There shall be no loss of adhesion at -60 degrees Fahrenheit when tested in accordance with ASTM C 711
7. Sag: 0.20 in max, full button when tested in accordance with ASTM D 2202
8. Staining: Sealant will not stain a painted test panel when tested in accordance with ASTM D 925, Method A
9. UV Resistance: There shall be no cracking, bleeding, or loss of elasticity after 1,000 hours of QUV exposure in accordance with ASTM G 154.
10. Wet Flammability: No less than 110 degree Fahrenheit flash point when determined in accordance with ASTM D 56
11. Coverage: Each gallon of sealant shall provide the following minimum coverage:
 - a. 1,500 lineal feet with 1/8 in bead
 - b. 690 lineal feet with 3/16 in bead
 - c. 390 lineal feet with 1/4 in bead.
12. Shelf Life: 18 months minimum in unopened container when stored at or below 90 degrees Fahrenheit.
13. Drying time: Non-skinning, remains permanently soft and tacky
14. Engageability: Sealant will easily engage and transfer to male joint at 10 degrees Fahrenheit
15. Service Temperature Range: -60 degrees Fahrenheit to 200 degrees Fahrenheit
16. Application Temperature Range: 10 degrees Fahrenheit to 120 degrees Fahrenheit
17. Non-Reactive: Will not darken, etch, or leave salt deposits on the test panel after two years
18. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

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2.5 SILICONE SEALANT

A. General: Provide sealants that meet the following specifications:

1. ASTM C 920, Type S, Grade NS, Class 25
2. AAMA 802.3, Type I and II
3. AAMA 805.2 Group C
4. AAMA 808.3
5. FS TT-S-001543A, Class A
6. FS TT-S-00230C, Class A B.

Color: Clear

C. Physical Properties: The sealant shall have the following additional physical properties:

1. Mechanical Properties: The sealant shall have the following mechanical properties as determined by ASTM D 412:
 - a. Tensile Strength: 150 psi minimum (Method A)
 - b. Modulus at 100% Elongation: 35 psi minimum
 - c. Elongation: 400% minimum
 - d. Recovery: 100%
2. Hardness: Maximum Shore A hardness of 15 when determined in accordance with ASTM C 661
3. Tack-free Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-15 minutes
4. Cure Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-12 hours
5. Service Temperature: -60 degrees Fahrenheit to 300 degrees Fahrenheit
6. Shelf Life: 9 months when stored in unopened original containers at 80 degrees Fahrenheit or less
7. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.6 ACRYLIC SEALANT

A. Color:

1. Clear
2. White
3. Gray

B. Physical Properties:

1. Percent Solids:
 - a. Colors: 75% minimum determined in accordance with ASTM D 1475
 - b. Clear: 70% minimum determined in accordance with ASTM D 1475
2. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 5 lb./in when tested in accordance with ASTM C 794
3. Weight per U.S. Gallon: 8.7 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475
4. Viscosity: The sealant shall meet the following conditions when tested in accordance with ASTM D 2452 with a 20g cone with a 0.104 in orifice at 60 psi at 77 degrees Fahrenheit in the indicated time:
 - a. Colors: 40-60 seconds
 - b. Clear: 35-45 seconds
5. Elongation: 200% minimum when tested in accordance with ASTM D 412

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6. Hardness: Maximum Shore A hardness of 55 when determined in accordance with ASTM C 661
7. Flash Point: No less than the following when tested in accordance with ASTM D 56 a.
 - Colors: 52 degrees Fahrenheit
 - b. Clear: 40 degrees Fahrenheit
8. Slump: 0.10" maximum when tested in accordance with ASTM D 2202
9. Vehicle Migration: No vehicle migration from the sealant edge when tested in accordance with ASTM D 2203 as modified by Section 2.8.1 of AAMA 800-10
10. Paintability: Compatible with Alkyds, enamels and lacquers post-solvent release
11. Service Temperature Range: Zero degrees Fahrenheit to 180 degrees Fahrenheit
12. Shelf Life: 18 months when stored in original, unopened containers at or below 80 degrees Fahrenheit

PART 3 – EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove laitance and form-release agents from concrete.
 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- D. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- G. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

END OF SECTION

SECTION 07951
CAULKING

PART 1: GENERAL:

1.01 DESCRIPTION:

- A. WORK INCLUDED: Throughout the project, caulk and seal all joints where shown on the Drawings and elsewhere as required to provide a positive barrier against passage of air and passage of moisture.

1.02 QUALITY ASSURANCE:

- A. Qualifications of Installers:
1. Proper caulking and proper installation of sealants require that installer be thoroughly trained and experienced in the necessary skills and thoroughly familiar with the specified requirements.
 2. For caulking and installation of sealants throughout the work, use only personnel who have been specifically trained in such procedures and who are completely familiar with the joint details shown on the Drawings and the installation requirements called for in this Section.

1.03 SUBMITTALS:

- A. General: Comply with provisions of Section 01300.
- B. Manufacturer's Data: Submit:
1. A 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.
- C. Samples: Accompanying the submittal required in Paragraph "B" submit samples of each sealant, each backing material, each primer, and each bond breaker proposed to be used.

1.04 PRODUCT HANDLING:

- A. Delivery and Storage: Deliver all materials of this Section to the jobsite in the original unopened containers with all labels intact and legible at time of use. Store only under conditions recommended by the manufacturers. Do not retain on the jobsite any material which has exceeded the shelf life recommended by its manufacturer.
- B. 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.
- C. 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 CAULKING:

- A. General: Except as otherwise approved by the Architect, in writing, use only the type of caulking described in this Article.
- B. Caulking Materials:

1. Around Fixed Glass "Storefront" Aluminum Frames use silicone based caulking in color matching the aluminum. This caulking furnished and installed by "storefront" aluminum installer.
2. Around Windows: (if any) Use DAP Acrylic Latex Caulk with Silicone, in color to match window color or approved equal.
3. Around Exterior Door Frames: Use DAP Acrylic Latex Caulk with silicone in "Clear" color or approved equal.
4. Miscellaneous Exterior Connections Between Dissimilar Materials: Use DAP Acrylic Latex Caulk with silicone in "Clear" color unless another standard color of the manufacturer would be more suitable.
5. Exterior Masonry Control Joints: Use Dow Corning 790 sealant or approved equal. Prime where required by manufacturer. Provide foam backer rod approved for use by sealant manufacturer.
6. Interior Caulking: Use DAP Acrylic Latex Caulk with silicone or approved equal. Color as selected from manufacturer's standard colors.
7. Caulking Joints Not Otherwise Specified: Use DAP Acrylic Latex Caulk with silicone or approved equal.
8. FIRE RATED WALLS AND NON-FIRE RATED WALLS: Top-of-walls, shall be sealed on both sides of wall with fire rated sealants: CP606, CP 672 firestop spray, Firestop joint Spray CFS-SP WB with respective UL No. as recommended by Hilti Company.
9. Fire rated wall penetrations shall be: FS-one intumescent fire stop sealant with respective UL No. recommended by Hilti Company.
10. Smoke and acoustical walls sealant shall be: CP506 Sealant, CP 572 Spray by Hilti.
11. Exterior/Interior of Masonry Walls Dow Corning 790 silicone sealant.

C. Prime:

1. In accordance with sealant manufacturer recommendations.

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 PREPARATION:

A. All Surfaces:

1. All surfaces in contact with caulking shall be dry, sound, and well brushed and wiped free from dust, and oil or grease.
2. Use solvent, where necessary, to remove oil and grease, wiping the surfaces with clean rags.
3. Remove all mortar from the joint cavity.
4. Where backstop is required, insert the approved backup material in the joint cavity to the depth required.

3.03 INSTALLATION OF SEALANTS:

- A. General: Prior to start of installation in each joint, verify the joint type, and verify that the required proportion of width of joint to depth of joint has been secured.
- B. Equipment: Apply sealant under pressure with hand or power-actuated gun or other appropriate means. Guns

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CAULKING

shall have nozzle of proper size and shall provide sufficient pressure to completely fill joints as designed.

- C. Masking: Thoroughly and completely mask all joints where the appearance of sealant on adjacent surfaces would be objectionable.
- D. Installation of Sealant: Install the sealant in strict accordance with the manufacturer's recommendations thoroughly filling all joints to the recommended depth.
- E. Tooling: Tool all joints to the profile recommended by the caulking manufacturer or as shown by details in the Drawings.
- F. Cleaning Up:
 - 1. Remove masking tape immediately after joints have been tooled.
 - 2. Clean adjacent surfaces free from sealant as the installation progresses. Use solvent or cleaning agent as recommended by the sealant manufacturer.

END OF SECTION

SECTION 08113
STEEL DOORS AND FRAMES

PART 1 - GENERAL

PART 2 - RELATED DOCUMENTS

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

2.2 GENERAL REQUIREMENTS

- A. Any door or frame shown on the floor plans and not specifically referenced in the door schedule shall be provided as identical to a similar opening and shall be included in the hollow metal supplier's base bid. If there is no similar opening, provide price to include a frame and door as recommended by the hollow metal manufacturer for that type of opening.
- B. All fire rated doors and frames shall be provided to comply with the local code requirements whether drawn that way or not as part of the hollow metal supplier's base bid.

2.3 SUMMARY

- A. This Section includes steel doors and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 4 Section "Unit Masonry Assemblies" for building anchors into and grouting frames in masonry and drywall construction.
 - 2. Division 8 Section "Custom Steel Doors and Frames" for doors manufactured according to the Hollow Metal Manufacturers Association's standards.
 - 3. Division 8 Section "Flush Wood Doors" for solid-core wood doors installed in steel frames.
 - 4. Division 8 Section "Door Hardware" for door hardware and weatherstripping.
 - 5. Division 8 Section "Glazing" for glass in steel doors and sidelights.
 - 6. Division 9 Section "Gypsum Board Assemblies" for spot grouting frames in gypsum board partitions.
 - 7. Division 9 Section "Painting" for field painting primed doors and frames.

2.4 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

2.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of electrical knockout boxes and preparations for power, signal, and control systems.
- C. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- D. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

2.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Label each individual glazed lite.
- D. Smoke-Control Door Assemblies: Comply with NFPA 105.
- E. Preinstallation Conference: Conduct conference at Project site for hollow metal frames requiring electrical knockout boxes to verify installation of conduit on frames.

2.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable shipping braces across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

2.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

2.9 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with this section requirements, provide products by one of the following:
 - 1. Ceco Door Products
 - 2. Curries Company
 - 3. Steelcraft
 - 4. Deansteel
 - 5. Amweld
 - 6. Other SDI members will be considered only if prior approval is given in accordance with substitution request requirements per General Requirements section. Non-SDI members will not be considered.

3.2 MATERIALS

- A. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; A60 (ZF180) metallic coating.

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- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Glazing: Comply with requirements in Division 08 Section "Glazing."

3.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1 3/4" thick doors of design indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel
 - 2. Core Construction Exterior: Manufacturer's standard vertically steel-stiffened core.
 - 3. Core Construction Exterior (Insulated): Manufacturer's standard polyurethane core.
 - a. Thermal-Rated (Insulated) Doors: Exterior doors, provide doors fabricated with thermal-rated assemblies with R Factor 11 or better.
 - 1) Locations: All exterior metal doors shall be insulated.
 - 4. Core Construction Interior: Manufacturer's standard Polystyrene core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - 5. Vertical Edges for Single-Acting Doors: Beveled edge
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 - 6. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
 - 7. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
 - 8. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheets. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gage (0.053-inch - 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
 - 2. Edges to be continuously wire welded, dressed, ground smooth and primed with compatible air-drying, rust-inhibitive primer.
 - 3. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Top of door to be flush and completely sealed joints in top edges of doors against water penetration.

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- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), minimum 18 gage (0.042-inch - 1.0-mm-) thick steel, Model 2 (Seamless face and edges).
 - 2. Edges to be tack welded, dressed, ground smooth and primed with compatible air-drying primer.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

3.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheets.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded joints, dressed, ground smooth and primed with compatible air-drying, rust-inhibitive primer, unless otherwise indicated.
 - 3. Frames for Level 3 Steel Doors: minimum 14 gage 0.067-inch- (1.7-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded joints, dressed, ground smooth and primed with compatible air-drying primer.
 - 3. Frames for Level 2 Steel Doors: minimum 16 gage 0.053-inch- (1.3-mm-) thick steel sheet.
 - 4. Frames 48-inches and wider in opening width are required to be minimum 14 gage 0.067-inch- (1.7-mm-) thick steel sheet.
 - 5. Frames for Wood Doors: minimum 16 gage 0.053-inch- (1.3-mm-) thick steel sheet.
 - 6. Frames for Borrowed Lights: minimum 16 gage 0.053-inch- (1.3-mm-) thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

3.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

3.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

3.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches (0.4 mm) thick.

3.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8
- C. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
- D. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 42-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
- E. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
- F. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
- G. Grout Guards: Weld guard boxes to frame at back of mortise hardware prep in frames at all hinge, strike and other recessed hardware preps regardless of grouting requirements.
- H. Provide A60 Galvannealed coating at frames in restrooms with showers/Jacuzzi, clean areas such as surgery rooms and surgical suites, clean rooms, and soil rooms.
- I. Anchors:
 - 1. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 2. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

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- 1) Two anchors per jamb up to 60 inches (1524 mm) high.
- 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
- 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
- 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches (1524 mm) high.
- 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
- 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
- 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
- 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.

Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacture regardless if specified in division 8 Door Hardware.

- c. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- d. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

J. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

K. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

L. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricators shop

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that glazed lites are capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
5. Gap for butted or mitered joints in glass stop should not exceed .0625-inch.

3.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 - 2. Exterior doors and frames to be primed with compatible air-drying, rust-inhibitive primer.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

4.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

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1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 6. Field Supplied Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 7. Grouting Requirements:
 - a. Do not grout head of frames unless reinforcing has been installed in head of frame.
 - b. Do not grout vertical or horizontal closed mullion members.
 8. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).

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- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
- 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
 - a. Secure exterior removable stops with security head screws.

4.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08200

WOOD DOORS

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. Solid-core doors and transom panels with wood-veneer faces.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.

B. Related Sections:

1. Division 6 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both wood doors and wood paneling.
2. Division 8 Section "Steel Doors and Frames" for astragals provided as part of a fire-rated labeled assembly and for door silencers provided as part of the frame.
3. Division 8 Section "Glazing" for glass view panels in wood doors.

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 1. Indicate dimensions and locations of mortises and holes for hardware.
 2. Indicate dimensions and locations of cutouts.
 3. Indicate requirements for veneer matching.
 4. Indicate doors to be factory finished and finish requirements.
 5. Indicate fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification (Provide the following required samples prior to placing an order for any doors):
 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

- E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain wood doors from single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
 - c. Telegraphing of core construction and delamination of face in decorative laminate-faced doors.
 - 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION, GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- B. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1.
- C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 1. Edge Construction: Provide 45, 60 and 90 minute fire-rated doors edge construction with intumescent seals concealed by outer stile (Category A). Comply with specified requirements for exposed edges.
 - 2. Edge Construction: Provide 20 minute fire-rated doors as Category B, with smoke and fire seals (supplied by seal manufacturer) applied to frame for 20 minute openings.
 - 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - 4. Pairs: Provide formed-steel edges and astragals with intumescent seals.
 - a. Finish steel edges and astragals with baked enamel.
- D. Mineral-Core Doors:
 - 1. Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.2 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Graham.
 - 2. Algoma Hardwoods.
 - 3. Eggers Industries.
 - 4. Marshfield Door Systems, Inc.
 - 5. V-T Industries Inc.
 - 6. Oshkosh.
- B. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: Select White Birch.
 - 3. Cut: Rotary Cut.
 - 4. Match between Veneer Leaves: Book Match.
 - 5. Assembly of Veneer Leaves on Door Faces: Center Balance match.
 - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
8. Transom Match: Continuous match.
9. Exposed Vertical Edges: Same species as faces.
10. Core: Particleboard type LD-2, Mineral core.
11. Construction: Five plies. Stiles and rails are bonded to core, and then entire unit abrasive planed before veneering.

2.3 LOUVERS AND LIGHT FRAMES

- A. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked-enamel- or powder-coated finish.
- B. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Electrical Raceways: Provide prewired raceways with standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
- C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- D. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 1. Fabricate door and transom panels with full-width, solid-lumber[, **rabbeted**,] meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- E. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: Clear.
 - 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.

END OF SECTION

SECTION 08305
ACCESS DOOR

PART 1: GENERAL

1.01 DESCRIPTION

- A. Work included: Furnish and deliver to the job site all doors specified herein needed for a complete installation at all gypsum board and plastered ceilings and walls one per room as required to allow access to MEP work for maintenance above the ceilings, coordinate locations with MEP drawings.
- B. Related work described elsewhere:
 - 1. Installing wood doors: Section 06200

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified herein as listed in Section 01085.

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 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 ACCESS DOORS

- A. ***Plaster Ceilings Wet Areas: Access doors shall be Karp Associates 1-800-888-4212 Model # DSC-210PL Stainless Steel 24" x 24", 16-gauge frame and doors shall be 14 gauge doors shall be equipped with lock or equal.***
- B. ***Gypboard Ceilings: Access doors shall be Karp Associates 1-800-888-4212 Model # KDW baked white enamel 24" x 24", 16-gauge frame and doors shall be 14 gauge doors shall be equipped with lock or equal.***

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 451T Storefront System – 2" x 4-1/2"** (50.8 mm x 114.3 mm) nominal dimension; Thermal; Center, Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick or Punched Opening Fabrication.
- B. Related Sections:
 - 1. Division 07951 "Caulking" for joint sealants installed as part of the aluminum storefront system
 - 2. Division 08413 "Aluminum-Framed Entrances and Storefronts"

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 Drawings.
 - a. Basic Wind Speed (MPH): **Refer to structural drawings for design criteria.**
 - b. Importance Factor (I, II, III): **Refer to structural drawings for design criteria.**
 - c. Exposure Category (A, B, C, D): **Refer to structural drawings for design criteria.**
- B. Storefront System Performance Requirements:
 - 1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of (____) lbs./sq. ft. inward and (____) lbs./sq. ft. outward. The design pressures are based on the (____) Building Code; (____) Edition. **Refer to structural drawings for design criteria.**

SECTION 08413
ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

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) or 0.61 (clear) or Project Specific (____) BTU/hr/ft²/°F.
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).

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.

SECTION 08413
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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.

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 and indicate field measurements on Shop Drawings.

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® 451T (thermal) Storefront System**
 - 3. 2" x 4-1/2" (50.8 mm x 114.3 mm) System Dimensions
 - 4. Glass: Center, Interior.
- B. Subject to compliance with requirements, provide a comparable product by the following:
 - 1. Manufacturer: (_____)
 - 2. Series: (_____)
 - 3. Profile dimension: (_____)
- C. 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 storefronts 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.
- D. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

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: Provide continuous solid aluminum fillers at head and jambs and drainable sills. 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.

SECTION 08413
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

- 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. **Thermal Barrier (Trifab® VG 451T):**
 - 1. Kawneer IsoLock® Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
 - a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action
- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. 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 Division 08800 Section "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. 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 sealant.

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2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors:
 - 1. **Series: 500 Tuffline Entrances.**
 - 2. **Finish/Color: See part 2.8 finishes.**
- B. Entrance Door Hardware:
 - 1. Finish hardware supplied under section 08710 installed under this section by storefront contactor.
 - 2. Provide weather stripping and sealants as recommended by storefront entrance manufacture.

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.

SECTION 08413
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

- B. Factory Finishing:
 - 1. **Kawneer Permanodic® AA-M10C22A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear).**

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.

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.

SECTION 08413
ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

- a. 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.
 - b. 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 08710 Finish Hardware

SECTION 08710 FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing and installing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor and finish hardware suppliers bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractors and hardware supplier's base bid. The General Contractor and hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies.
- B. The General Contractor and the Hardware Supplier shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor and hardware supplier to address any such issue shall be considered acceptance of the hardware specified and all discrepancies shall be corrected at the General Contractor and hardware supplier's expense and considered a part of their base bid. Change orders shall not be issued if deemed by the Architect and/or Hidalgo County Representative under and/or be covered as a part of the General Contractors or hardware supplier's base bid, due to failure to comply with this instruction notification.
- C. Items include but are not limited to the following:
 - 1. Hinges - Pivots
 - 2. Flush Bolts
 - 3. Exit Devices
 - 4. Locksets and Cylinders
 - 5. Push Plates - Pulls
 - 6. Coordinators
 - 7. Closers
 - 8. Kick, Mop and Protection Plates
 - 9. Stops, Wall Bumpers, Overhead Controls
 - 10. Electrified Hold Open Devices
 - 11. Thresholds, Seals and Door Bottoms
 - 12. Silencers
 - 13. Miscellaneous Trim and Accessories

1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this specification section:

- A. Section 06 20 00 - Finish Carpentry
- B. Section 08 11 00 - Hollow Metal Work

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- C. Section 08 20 00 - Wood Doors
- D. Sections within 08 30 00 - Specialty Doors
- E. Section within 08 40 00 - Entrance and Storefronts
- F. Sections within 08 80 00 - Glazing
- G. Sections within 09 90 00 - Painting
- H. Division 16 – Electrical
- I. Division 28 - Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80 - Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL – Under-writer's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2015 – International Building Code as applicable
- L. NFPA-70 – National Fire Code

1.05 SUBMITTALS

- A. **HARDWARE SCHEDULES** submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to all these specifications as required.
 - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

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- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience (minimum fifteen (15) years in the industry) who will be made available at reasonable times to consult with the Architect/Contractor and/or Hidalgo County Representative regarding any matters affecting the finish hardware on this project.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a Two- (2) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

- 1. All Closers are to have a thirty- (30) year written warranty.
- 2. All Exit Devices are to have a three- (3) year written warranty.
- 3. All Grades 1 Locksets are to have a ten- (10) year written warranty.
- 4. All Continuous Hinges are to have a ten- (10) year written warranty.

PART 2 – PRODUCTS

2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with wood screws and plastic anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of all fastenings shall harmonize with the hardware as to material and finish.

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- D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

Hardware shipped to the project jobsite shall be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Hager or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).
- C. Exterior Door Hinges
Provide out-swinging door hinges of Steel or Stainless Steel with non-removable pins or security studs, polished and/or plated to match specified finish as called for in 3.02 Hardware Sets.
- D. Interior Door Hinges
Material shall be Wrought Steel or Stainless Steel, polished and/or plated to match specified finish. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof (Reference Hardware Sets 3.02).
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide. Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 5" x 4½" unless otherwise noted in 3.02 Hardware Sets.
- F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width.
- H. At labeled door's Steel or Stainless Steel, bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.
- I. Continuous hinges shall be Ives as specified or equal products manufactured by ABH or Select Products shall be considered acceptable. Hinges shall be rated and successfully tested to carry a door weight of 450 pounds or higher. All Continuous Hinges shall be Fire Rated for use on 90 Minute and 180 Minute fire doors (Depending on Hinge Type Specified, Reference Hardware Sets 3.02).

2.04 LOCK AND LOCK TRIM

- A. All the locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locksets shall be provided as specified and are Schlage "ND/L9000" series with the "Sparta/17A" lever.

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- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
- C. Mechanical Locks shall meet ANSI Operational Grades 1, Series 1000/4000 as specified.
 - 1. Hand of lock is to be field reversible or non-handed.
 - 2. All lever trim is to be through-bolted through the door.
 - 3. All pairs of doors shall be supplied with a 3/4" latch bolt throw.

2.05 CYLINDERS AND KEYING

- A. Provide locks and Exit devices requiring cylinders with Schlage Large Format Interchangeable Cores keyed to the Existing/New System and comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. All locks are to be keyed to the existing key system by the Hidalgo County Representative. The Hardware Supplier shall verify the keyway required prior to submitting for approval with the Hidalgo County Representative. The hardware supplier shall provide one (1) Knox Box if required by the local Fire Marshall. The contractor shall install the Knox Box as required by the local Fire Marshall and Hidalgo County Representative.
- B. Factory stamp all keys "Do not duplicate" and with key symbol as directed by the building Hidalgo County Representative. Visual Key Control shall be provided as required by Hidalgo County Representative (Key and Core).
- C. Provide keyed construction cores for the full duration of the construction phase. Provide ten (10) construction keys and two (2) construction control keys total.
- D. General Contractor shall set up a meeting between the Hardware Supplier and Hidalgo County Representative at the project site to determine all permanent keying requirements, quantity of cut keys and quantity of blank keys to be provided,

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements. Furnish roller strikes for all rim and surface vertical rod exit devices.
- D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets ("17" design) if specified. Install all Exit Device with the manufacturers standard screws furnished with the device (NO EXCEPTIONS).

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- E. Exit Devices to be the modern push rail design. All exit devices shall be mounted with sex bolts. Exit Devices shall be field modifiable to receive electrified functions without the purchase of new Exit Devices.
- F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship. Exit devices shall be certified by an independent testing lab for a minimum of 1,000,000 cycles.
- G. Exit Devices shall be Von Duprin "99" series as specified.

2.07 SURFACE MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified other wise.
- D. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer. Provide closer covers only if provided as a standard part of the door closer package.
- E. Closers shall have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacture for a proper and functional installation as part of their base bid.
- F. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the Hardware Sets 3.02.
 - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.
 - 2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- G. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening. Drop plates and any additional brackets required for the proper installation of the door closer shall be included in the hardware supplier's base bid.
- H. Finish: Sprayed enamel finish shall match other hardware.
- I. Provide and mount all door closers with sex bolts as provided by the manufacturer. Install surface closer as to allow the door to swing the full degree of opening.
- J. Closers shall be LCN "4040XP/1461" series as specified or acceptable product Manufactured by Sargent 281 series.

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2.09 DOOR STOPS AND HOLDERS

- A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified. The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.
- D. Finish: Same as other hardware where available.
- E. Acceptable Products
 - 1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood, Glynn Johnson and Trimco are acceptable.

2.10 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood, Glynn Johnson and Trimco are acceptable.
- B. Kick plates to be 10 inches high by 2 inches less than door width (LDW) as specified. They shall be of 16-gauge thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- C. Finish shall be Stainless Steel (US32D/630) as specified.

2.11 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Rockwood, Glynn Johnson and Trimco are acceptable. Finish shall match the adjacent hardware.

2.12 THRESHOLDS AND SEALS

- A. Provide materials and finishes as listed in hardware sets and Manufactured by Zero. Equivalent product by National Guard Products and Reese are acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with wood screws and plastic anchors. Supply all necessary anchoring devices for weather strip and sound seal.
- C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather strip inserts shall be a silicone-based product as specified in 3.02 Hardware Sets.

Section 08710 Finish Hardware

- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.
- E. Provide all thresholds with a special none slip coating, "E" as manufactured by Zero as listed in the hardware sets.

2.13 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.14 DOOR SILENCERS AND KEY CABINET

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three- (3) or four- (4) for each single door (coordinate with the frame manufacturer). Provide a key cabinet Lund 1200 for installation by the contractor as instructed by the Architect and Hidalgo County Representative.
- B. The hardware supplier shall assist the building owner in the tagging of all keys and instruct the Hidalgo County staff as to the proper use of the key cabinet system. Training shall include industry standard procedures for maintaining a key system. The hardware supplier shall provide the Hidalgo County Representative with two- (2) complete full-size copies of the floor plans complete with the door number and key symbol shown at each door opening. One- (1) copy shall be placed in the key cabinet and one- (1) copy shall be turned over to the Hidalgo County Representative. Training shall be based on four- (4) hours maximum. The hardware supplier shall send a list of all staff members trained in the proper use of the key cabinet to the Hidalgo County Representative and the Architect.

2.15 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the Hidalgo County Representative.
- E. Architect and the Hidalgo County Representative reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

- A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.

Section 08710 Finish Hardware

- B. The hardware supplier's office and/or warehouse shall be located within a seventy-five (75) mile radius of the project site as to better service the general contractor and the Hidalgo County Representative during this project.
- C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- D. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

HARDWARE GROUP NO. 001 - OFFICES

FOR USE ON MARK/DOOR #(S):

A127 A128 A129 A117 A108

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE LOCK	ND53TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 002 - ACCESS CONTROLLED - INTERIOR

FOR USE ON MARK/DOOR #(S):

A131C A131B A126 A104C

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	STOREROOM LOCK	ND80TDEU SPA RX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 RA/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	DOOR SCOPE 360 VIEWER	DC2000-SILVER-2 1/8"	SIV	D-C
3	EA	SILENCER	SR64	GRY	IVE
		POWER SOURCE	PROVIDED BY OTHER		
		CARD READER	PROVIDED BY OTHER		
		DOOR CONTACT	PROVIDED BY OTHER		

Section 08710 Finish Hardware

HARDWARE GROUP NO. 003 - ACCESS CONTROLLED - MDF

FOR USE ON MARK/DOOR #(S):

A111

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	STOREROOM LOCK	ND80TDEU SPA RX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 RA/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
		POWER SOURCE	PROVIDED BY OTHER		
		CARD READER	PROVIDED BY OTHER		
		DOOR CONTACT	PROVIDED BY OTHER		

HARDWARE GROUP NO. 004 – STORAGE & JANITOR

FOR USE ON MARK/DOOR #(S):

A120 A118 A115 A110 A106 A125

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	DOOR STOP	WS406/407CCV OR FS410 AS REQ.	630/626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 005 – FIRE RISER

FOR USE ON MARK/DOOR #(S):

A136

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	RAIN DRIP	142A-FRAME WIDTH + 4"	A	ZER
1	EA	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	39AA-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	65A-224-FRAME WIDTH	A	ZER

Section 08710 Finish Hardware

HARDWARE GROUP NO. 006 - ACCESS CONTROLLED - EXTERIOR

FOR USE ON MARK/DOOR #(S):

A112 A131A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 TW8	652	IVE
1	EA	ELECTRIC PANIC DEVICE	EL-RX-99-L-NL-996-17-SNB	628	VON
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 RA/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	8303AA PSA-H & J	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-224	A	ZER
1	EA	DRIP CAP	142A-FRAME WIDTH + 4"	A	ZER
1	EA	POWER SOURCE CARD READER DOOR CONTACT	PS914 900-BBK PROVIDED BY OTHER PROVIDED BY OTHER		VON

HARDWARE GROUP NO. 007 - ACCESS CONTROLLED - EXTERIOR

FOR USE ON MARK/DOOR #(S):

A100 A124

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONTINUOUS HINGE	A110HD-R TW8-DOOR HEIGHT	628	ABH
1	EA	ELEC PANIC HARDWARE	RX-QEL-3347-EO	US28	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-3347-NL-OP-110MD	US28	VON
1	EA	FSIC CORE	23-030	626	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	622	SCH
1	EA	LFIC CYLINDER	RIM/MORTISE AS REQ.	626	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 10" O	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30	689	LCN
1	EA	RAIN DRIP	142A-FRAME WIDTH + 4"	AA	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	AA	ZER
1	EA	THRESHOLD	655A-224-FRAME WIDTH	A	ZER
		POWER SOURCE CARD READER DOOR CONTACT WETHERSTRIP	PROVIDED BY OTHER PROVIDED BY OTHER PROVIDED BY OTHER PROVIDED BY THE DOOR/FRAME MFG		

HARDWARE GROUP NO. 008 - RESTROOMS

**Hidalgo County Precinct No 1
New Tax Office and Precinct Building Renovation
Weslaco, Texas**

Section 08710 Finish Hardware

FOR USE ON MARK/DOOR #(S):

A102 A103 A134 A135

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	INDICATOR PRIVACY	L9040 17A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	1461 RA/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 009 – WORK ROOM

FOR USE ON MARK/DOOR #(S):

A132

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S SPA	626	SCH
1	EA	SURFACE CLOSER	1461 RA/PA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 010 – FIRE RATED – ELECTRICAL ROOM

FOR USE ON MARK/DOOR #(S):

A113

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC PANIC DEVICE	99-L-NL-F-996-17-SNB	628	VON
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 SCUSH TBSRT	689	LCN
1	EA	GASKETING	8145S BK PSA-H & J	BK	ZER

HARDWARE GROUP NO. 011 – FIRE RATED – VAULT ROOM

FOR USE ON MARK/DOOR #(S):

A114

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	DEADLOCK	B660TD	626	SCH

**Hidalgo County Precinct No 1
New Tax Office and Precinct Building Renovation
Weslaco, Texas**

08710- 12

Section 08710 Finish Hardware

1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HDPA TBSRT	689	LCN
1	EA	FLOOR STOP	FS18S	BK	IVE
1	EA	GASKETING	8145S BK PSA-H & J	BK	ZER

HARDWARE GROUP NO. 012 – RECEPTION/SECURITY

FOR USE ON MARK/DOOR #(S):

A105

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE LOCK	ND53TD SPA	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	1461 HD TBSRT	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 013 – VESTIBULE

FOR USE ON MARK/DOOR #(S):

A104A

A104B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH/PULL BARS	EZHD9190-10" X DOOR WIDTH O/N	630	IVE
			MOUNTING		
1	EA	SURFACE CLOSER	1461 EDA	689	LCN
1	EA	DROP PLATE	1461-18PA	630	IVE
1	EA	OH STOP	100S	630	GLY
		SEAL	PROVIDED BY THE DOOR MFG		

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.

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. *Exterior doors and windows.*

Type: Solar Control Low-E Clear Insulating Glass
“Solarban®” 70XL (2) “Solargray” + Clear by PPG Industries, Inc.

Outdoor Lite: “Solargray” Tempered Glass by PPG Industries, Inc., Sputter Coated on second surface (2)

Indoor Lite: Clear Tempered Glass

Low-E Coating: “Solarban” 70XL Solar Control (Sputtered) by PPG Industries, Inc.

Location: Second Surface (2)

Performance Values

SECTION 08800
GLASS AND GLAZING

Visible Light Transmission	U-Value Winter	U-Value Summer	SHGC	Shading Coefficient	Outdoor Visible Light Reflectance
31%	0.28	0.26	0.19	0.22	7%

Approved Manufacturers: PPG Certified Fabricator

Certification: Both lites to be Cradle to Cradle certified, minimum Silver Level, by McDonough Braungart Design Chemistry, LLC (MBDC www.mbdc.com).

Outdoor Appearance: Cool Gray

Insulating Unit Construction: ¼" (6mm) glass + ½" (13mm) air space + ¼" (6mm) glass

B. Where type of glass indicated on the drawings the following applies:

1. ***Fire rated interior doors and windows: 3/16" thick fire lite NT by TGP or equal.***
2. ***Reference Section 08810 fire rated glass for more information.***
3. ***Non-fire rated interior doors and windows: ¼" thick laminated, clear.***
4. ***At all hollow metal doors: ¼" 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.

SECTION 08800
GLASS AND GLAZING

- 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: 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 cut. 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. Where control joints are not shown on drawings provide control joints as recommended by conventional lath and plaster construction by USG.
- 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 at all fascia/soffit intersections 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 paperback 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: Certain Teed Company
Georgia-Pacific Corporation
National Gypsum Company
United States Gypsum Company
Temple-Inland

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. WATER – RESISTANT WALL BOARD: ASTM C360, (Fire code where required) 5/8" thick, unless otherwise indicated. Shall be installed in all wet wall locations.

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 stud 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 09300
TILING

PART 1 GENERAL

PART 2

2.1 SECTION INCLUDES:

- A. Tile and Accessories:
 - 1. Quarry
 - 2. Wall Glazed.
 - 3. Mosaics Floor.
 - 4. Trim and Accessories.
 - 5. Setting Materials.

2.2 REFERENCES:

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108.01 General Requirements – Subsurfaces and Preparations By Other Trades.
 - 2. ANSI A108.1A - Specifications for Installation of Ceramic Tile in the Wet-Set Method with Portland cement Mortar.
 - 3. ANSI A108.1B - Specifications for Installation of Ceramic Tile on a Cured Portland cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
 - 4. ANSI A108.10 - Specifications for Installation of Grout in Tilework.
 - 5. ANSI A137.1 Standard Specification For Ceramic Tile.
- B. ASTM International (ASTM):
 - 1. ASTM C 50 - Standard Practice for Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products.
- C. Tile Council of North America (TCNA): TCA Handbook for Ceramic Tile Installation, 2013.

2.3 PERFORMANCE REQUIREMENTS:

- A. Dynamic Coefficient of Friction: Tile on walkway surfaces shall be provided with the following values as determined by ANSI A137.1 Section 9.6:
 - 1. Tile shall have a DCOF of .42.

2.4 SUBMITTALS:

- A. Submit under provisions of Section 01300.
- B. [Product Data]: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Selection Samples: Color charts illustrating full range of colors and patterns.
- E. Selection Samples: Samples of actual tiles for selection.
- F. Samples: Mount tile and apply grout on two plywood panels, illustrating pattern, color variations, and grout joint size variations.

- G. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified requirements.
 - 2. For each shipment, type and composition of tile provide a Master Grade Certificate signed by the manufacturer and the installer certifying that products meet or exceed the specified requirements of ANSI A137.1.
- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

2.5 QUALITY ASSURANCE:

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum two years experience.
- B. Single Source Responsibility: Obtain each type and color of tile from a single source. Obtain each type and color of mortar, adhesive and grout from the same source.

2.6 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver and store products in manufacturer's unopened packaging until ready for installation.
- B. Protect adhesives and liquid additives from freezing or overheating in accordance with manufacturer's instructions.
- C. Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

2.7 ENVIRONMENTAL REQUIREMENTS:

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during tiling and for a minimum of 7 days after completion.

2.8 EXTRA MATERIALS:

- A. Provide for Owner's use a minimum of 2 percent of the primary sizes and colors of tile specified, boxed and clearly labeled.

PART 3 PRODUCTS:

3.1 MANUFACTURERS:

- A. Acceptable Manufacturer: DalTile Corporation, which is located at: 7834 C.F. Hawn Fwy. P. O. Box 170130 ; Dallas, TX 75217; Toll Free Tel: 800-933-TILE; Tel: 214-398-1411; Fax: 214-309-4584; Email: todd.lehr@daltile.com; Web: www.daltileproducts.com
- B. American Olean Company.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01631.

3.2 TILE:

- A. General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings and identified in the Schedule and the end of this Section. Tile shall also be provided in accordance with the following:
 - 1. Factory Blending: For tile exhibiting color variations within the ranges selected under

Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.

2. Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.
3. Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.

A. Quarry Tile Floors:

1. **Quarry Tile:**
2. **Moisture Absorption:** *Less than .07 percent to less than 20 percent.*
3. **Size and Shape:** *6 inches by 6 inches by 3/8" thick, nominal.*
4. **Surface finish:** *Suretread.*
5. **Surface Finish:** *Abrasive.*
6. **Colors:** *To be selected from manufacturer's standard range.*
7. **Trim Units:** *Matching bullnose, bullnose corner, cove base, outside cove corner shapes in sizes coordinated with field tile shapes.*

B. Wall Glazed Tile:

1. **Moisture Absorption:** *Less than .5 percent to less than 20 percent.*
2. **Size and Shape:** *4 1/4"x4 1/4"x 1/8" thick nominal.*
3. **Surface Finish:** *Glazed vitreous body colored, matte finish.*
4. **Colors:** *70% color group 2, 20% color group 4 (accent) colors and 10% color group 5 (accent) colors.*
5. **Patters:** *As selected by architect.*
6. **Trim Units:** *Matching cove base, cove base corner, bullnose, outside cove corner shapes in sizes coordinated with field tile.*

C. Mosaic Porcelain Floor Tile:

1. **Moisture Absorption:** *Less than .5 percent to less than 20 percent.*
2. **Size and Shape:** *2"x2"x 3/16" thick nominal.*
3. **Surface Finish:** *Unglazed Vitreous body.*
4. **Colors:** *70% Group 2, 20% Group 4 and 10% Group 5 (accent) colors.*
5. **Pattern:** *As selected by architect*
6. **Trim Units:** *Matching cove base, cove base corner, bullnose, outside cove corner shapes in sizes coordinated with field tile shall be part of the wall tile selections.*

3.3 TRIM AND ACCESSORIES:

A. Acceptable Manufacturers:

1. Schluter Systems.
2. Custom Building Products.

B. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive; use in the following locations:

1. Open edges of floor tile.
2. Transition between floor finishes of different heights.
3. Thresholds at door openings.
4. Expansion and control joints, floor and wall.

3.4 SETTING MATERIALS:

A. Acceptable Manufacturers:

1. Bostik Inc.
2. Custom Building Products.
3. Laticrete International Inc.

- B. Mortar Bed Materials:
 - 1. Portland cement: ASTM C150, type 1,
Colors: Charcoal Color for floors and white for walls.
 - 2. Hydrated Lime: ASTM C207, Type S.
 - 3. Sand: ASTM C144, fine.
 - 4. Latex additive: As approved.
 - 5. Water: Clean and potable.
- C. Mortar Bond Coat Materials:
 - 1. Dry-Set Portland Cement type: ANSI A118.1.
 - 2. Latex-Portland Cement type: ANSI A118.4.
 - 3. Chemical-Resistant Furan Mortar & Grout: ANSI A118.5 ***where required by application.***
- D. Standard Grout: Cement grout, sanded or unsanded, as specified in ANSI A118.6; color as selected.
- E. Silicone Sealant: Silicone sealant, moisture and mildew resistant type, white; use for shower floors and shower walls.
- F. Where required provide Cleavage Membrane:
 - 1. No. 15 (6.9 kg) asphalt saturated felt, ASTM D226, Type 1.
 - 2. Polyethylene film, ASTM D4397, 4.0 mil thickness.
- G. Where required provide Waterproofing Membrane at Floors: Membrane in accordance with ANSI A118.10 and as follows:
 - 1. Chlorinated Polyethylene Sheet with polyester fabric reinforcing.
 - 2. Fabric Reinforced, Fluid-Applied elastomeric membrane.
 - 3. Un-Reinforced, Fluid-Applied elastomeric membrane.
 - 4. Polyethylene Sheet Product.
 - 5. Fabric-Reinforced, Modified-Bituminous Sheet Product.
 - 6. Urethane Waterproofing and Tile-Setting Adhesive Product.
- H. Membrane at Walls: No. 15 (6.9 kg) asphalt saturated felt, ASTM D226, Type 1.
- I. Membrane at Walls: 4 mil (0.1 mm) thick polyethylene film, ASTM D4397.
- J. Membrane at Walls: Reinforced asphalt paper.
- K. Reinforcing Mesh: 2 by 2 inch (50 by 50 mm) size weave of 16/16 wire size; welded fabric, galvanized.
- L. Metal Lath: ASTM C847, Flat expanded diamond mesh, not less than 2.5 lbs/SY, galvanized finish.
- M. Where required provide Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced with 2 inch (50 mm) wide coated glass fiber tape for joints and corners:
 - 1. Thickness: 5/8 inch (16 mm). Dense Shield Tile Backer Board.

PART 4 EXECUTION:

4.1 EXAMINATION:

- A. Verify that wall surfaces are free of substances which would impair bonding of setting materials, smooth and flat within tolerances specified in ANSI A137.1, and are ready to receive tile.
- B. Verify that sub-floor surfaces are dust-free, and free of substances which would impair bonding of

setting materials to sub-floor surfaces, and are smooth and flat within tolerances specified in ANSI A108.01.

- C. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

4.2 PREPARATION:

- A. Protect surrounding work from damage.
- B. Remove any curing compounds or other contaminants.
- C. Vacuum clean surfaces and damp clean.
- D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- E. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- F. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

4.3 INSTALLATION – GENERAL:

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCA Handbook recommendations.
- B. Lay tile to pattern indicated. Arrange pattern so that a full tile or joint is centered on each wall and that no tile less than 1/2 width is used. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Install thresholds where indicated.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- K. Allow tile to set for a minimum of 48 hours prior to grouting.
- L. Grout tile joints. Use standard grout unless otherwise indicated.
- M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

4.4 INSTALLATION - FLOORS - THIN-SET METHODS:

- A. Over exterior concrete substrates, install in accordance with TCA Handbook Method F102, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-portland cement grout.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F131.
- C. Over wood substrates, install in accordance with TCA Handbook Method F150, with standard grout, unless otherwise indicated.
 - 1. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F143.

4.5 INSTALLATION - FLOORS - MORTAR BED METHODS:

- A. Over exterior concrete substrates, install in accordance with TCA F101, bonded, with standard grout.
- B. Over interior concrete substrates, install in accordance with TCA Handbook Method F111, with cleavage membrane, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCA Handbook Method F121.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F132, bonded.
 - 3. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCA Handbook Method F114, with cleavage membrane.
- C. Over wood substrates, install in accordance with TCA Handbook method F141, with standard grout, unless otherwise indicated.
- D. Cleavage Membrane: Lap edges and ends.
- E. Waterproofing Membrane: Install as specified in ANSI A108.13.
- F. Mortar Bed Thickness: 1-1/2 to 2 inch maximum, unless otherwise indicated.

4.6 INSTALLATION WHERE REQUIRED - SHOWERS AND BATHTUB WALLS:

- A. At tiled shower receptors install in accordance with TCA Handbook Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. At bathtub walls install in accordance with TCA Handbook Method B412, over cementitious backer units with waterproofing membrane.
- C. Grout with standard grout as specified above.
- D. Seal joints between tile work and other work with sealant specified in Section 07900.

4.7 INSTALLATION - WALL TILE:

- A. Over cementitious backer units on studs, install in accordance with TCA Handbook Method W244, using membrane at toilet rooms.
- B. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise indicated.
 - 1. Where mortar bed is indicated, install in accordance with TCA Handbook Method W222, one coat method.

- 2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCA Handbook Method W222, one coat method.
- C. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.
- D. Over wood studs without backer install in accordance with TCA Handbook Method W231, mortar bed, with membrane where indicated.
- E. Over metal studs without backer install in accordance with TCA Handbook Method W241, mortar bed, with membrane where indicated.

4.8 CLEANING & SEALING:

- A. Clean wall tile and grout surfaces with cleaning agents recommended by manufacturer.
- B. Mosaic floor tile shall be cleaned with Aqua Mix Ex-Treme as per manufacturers' recommendations.
- C. Mosaic floor tile shall be sealed with Aqua Mix Gold as per manufacturers' recommendations.

4.9 PROTECTION OF FINISHED WORK:

- A. Do not permit traffic over finished floor surface for 72 hours after installation.
- B. Cover floors with kraft paper and protect from dirt and residue from other trades.
- C. Where floor will be exposed for prolonged periods cover with plywood or other similar type walkways

END OF SECTION

SECTION 09310
CERAMIC TILE - GENERAL
(THIS SECTION PART OF SECTIONS 09312 AND 09316)

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. Dallas Ceramic Company
 - c. Lone Star Ceramics Company
 - d. American Olean Tile Company
 - e. Monarch Tile Company
 - f. Winburn Tile Company
 - 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 – white
 - b. Floor: Dark Gray

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, **80% color group 2 and 20% color group 3 (accent)** 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 from Price Group 2 vitreous body, natural clay type, 1/4" thick, cushion edges, size 2"x 2" with slip resistant.
- 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
AND DRY WALL GRID 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
 - f. USG COMPANY

2.02 MATERIALS

2.03 STEEL EXPOSED SUSPENSION SYSTEM: USG CHICAGO (FIRE FRONT 250) FIRE RATED SYSTEM Chemically cleansed, electrogalvanized and bonderized, with high-baked enamel finish on all parts and painted white enamel finish on expose surfaces, ASTM C-635, maximum deflection 0.133 inch, Intermediate Duty.

- 1. Main Beams: 0.015-0.020-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: 0.015-0.020-inch minimum steel, 1 1/2" 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: .018-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. Manufactured with fire expansion reliefs.
- 7. WIRE: 12 gauge galvanized, soft annealed, mild steel wire.
- 8. Fire rating install at all fire rated ceilings, meeting UL fire rated assemblies.

SECTION 09501
ACOUSTICAL CEILINGS STEEL EXPOSED SUSPENSION
SYSTEM AND DRY WALL GRID SYSTEM

2.04 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 expose surfaces, ASTM C-635, maximum deflection 0.133 inch, intermediate Duty.

1. Main Beams: 0.015-0.020-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: 0.015-0.020-inch minimum steel, 1½" 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: .018-inch minimum steel, 1½" 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. WIRE: 12 gauge galvanized, soft annealed, mild steel wire.

2.05 AT KITCHEN CEILINGS PROVIDE AND INSTALL ALUMINUM BEAMS AND CROSS TEES.

2.06 NON-FIRE RATED DRYWALL GRID SYSTEM

- A. Manufacturers
Chicago Metallic (660-C) heavy duty double web suspension system.
- B. Suspension System Components
- C. Furring Runners: Manufactured from 0.020-inch-thick steel, 1-3/8-inch-wide knurled face by 1-1/2 inches high by 144 inches long with factory punched cross tee slots, hanger holes, and non-directional bayonet end tab couplings.
- D. Furring Tees: Manufactured from (0.020) inch thick, 1-3/8-inch-wide, knurled face by 1-1/2 inches high by 48 inches long with (stab-type end tab) (hook-type end tab) couplings, factory punched cross tee slots, and hanger holes.
- E. Furring Cross Channel:
 1. Manufactured from 0.020-inch-thick steel, 1-3/8-inch-wide knurled face by 7/8 inches high by 48 inches long with straight locking end tabs.
- F. Cross Tees:
 1. Manufactured from 0.020-inch-thick steel, 15/16-inch-wide by 1-1/2 inches high by 48 inches long with stab-type end tab couplings, factory punched cross tee slots, and hanger holes.
 2. Coated with factory applied white baked-on enamel paint finish.
- G. Wall Track:
 1. Manufactured from 0.020-inch-thick steel 1-9/16 inches high by 120 inches long with a 1-inch top and bottom flange.

2.07 FIRE RATED DRYWALL GRID SYSTEM

- A. Manufacturers
Chicago Metallic (670-C) heavy duty double web suspension system.
- B. Suspension System Components
- C. Furring Runners: Manufactured from 0.020-inch-thick steel, 1-3/8-inch-wide knurled face by 1-1/2 inches

SECTION 09501
ACOUSTICAL CEILINGS STEEL EXPOSED SUSPENSION
SYSTEM AND DRY WALL GRID SYSTEM

- high by 144 inches long with factory punched cross tee slots, hanger holes, and non-directional bayonet end tab couplings.
- D. Furring Tees: Manufactured from (0.020) inch thick, 1-3/8-inch-wide knurled face by 1-1/2 inches high by 48 inches long with (stab-type end tab) (hook-type end tab) couplings, factory punched cross tee slots, and hanger holes.
- E. Furring Cross Channel:
1. Manufactured from 0.020-inch-thick steel, 1-3/8-inch-wide knurled face by 7/8 inches high by 48 inches long with straight locking end tabs.
- F. Cross Tees:
1. Manufactured from 0.020-inch-thick steel, 15/16-inch-wide by 1-1/2 inches high by 48 inches long with stab-type end tab couplings, factory punched cross tee slots, and hanger holes.
 2. Coated with factory applied white baked-on enamel paint finish.
- G. Wall Track:
1. Manufactured from 0.020-inch-thick steel, 1-9/16 inches high by 120 inches long with a 1-inch top and bottom flange.

PART 3: EXECUTION

3.01 EXAMINATION

- 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 moldings 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 1/360 span.
- E. Install cross tees at right angles to beam cross tees to support ends of light fixtures, diffusers or grilles.
- F. At fire rated ceiling locations install suspended grid system in accordance to U.L. assemblies.

3.03 INSTALLATION-NON FIRE RATED SYSTEM FOR DRYWALL GRID SYSTEM

- A. Furring Runners: Installed 48 inches on center, by direct suspension from existing structure, with not less

SECTION 09501
ACOUSTICAL CEILINGS STEEL EXPOSED SUSPENSION
SYSTEM AND DRY WALL GRID SYSTEM

- than 12-gauge hanger wires spaced 48 inches on center along main runner length. Wrap hanger wires tightly 3 full turns at each end.
- B. Furring Tees: Installed perpendicular to furring runners (16) (24) inches on center to form 24 by 24 modules.
 - C. Cross Tees: Installed adjacent to each unsupported side of recessed fixtures.
 - D. Wall Track: Installed on vertical surfaces, intersecting suspension components, by appropriate method in accordance with industry accepted practice.
 - E. Additional Hanger Wires: Wrapped tightly 3 full turns to structure and component at locations where imposed loads could cause deflection exceeding 1/360 span.

3.04 INSTALLATION-FIRE RATED SYSTEM DRY WALL SYSTEM

- A. Installed in accordance with U.L. assemblies.

3.05 REPAIR

- A. Remove damaged components, replace with undamaged components.

3.06 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
- B. Do not use toothpaste, baby powder or similar material to disguise blemishes.

END OF SECTION

SECTION 09511
ACOUSTICAL CEILING LAY-IN PANELS

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Acoustical Ceiling Lay-In Panels indicated by the Contract Documents and furnish all supplementary items 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 SUBMISSIONS

- A. Samples: Submit 12"x12" samples of each type acoustical unit specified. Submit 12" long sample of angle molding.
- B. Shop Drawings: Show complete pattern layout, setting diagrams and arrangement of acoustical units. 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. ACOUSTICAL UNITS:

Armstrong Building Products	The Celotex Corporation
Conwed Corporation	Certaineed Ceilings
United States Gypsum	

2.02 MATERIALS:

- A. Armstrong Design Basis:
 - 1. Clean Room UL 24" x 24" x 5/8", Item #868.
 - 2. School Zone Fine Fissured 24" x 24" x 3/4", Item #1713.
 - 3. School Zone Fine Fissured, fire rated UL assembly 24" x 24" x 3/4", Item #1810.
 - 4. School Zone Fire Fissured: 24" x 48" x 3/4", Item #1714.
- B. Certain Teed Design basis ceiling tiles:
 - 1. Vinyl Shield A 24" x 24" x 5/8", A1102-CRF-1
 - 2. Fine Fissured 24" x 24" x 3/4", HHF-457 HNRC
 - 3. Fine Fissured fire rated UL assembly 24" x 24" x 5/8", PFF-157
 - 4. Fine Fissured 24" x 24" x 3/4", HHF-497-HNRC

PART 3: EXECUTION

3.01 PREPARATION

- A. Examine spaces and correct defects that could interfere with proper installation. Installed ceiling 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

SECTION 09511
ACOUSTICAL CEILING LAY-IN PANELS

conditions closely approximating the interior conditions which will exist when the building is occupied but not less than 50°F. or more than 85°F. before, during and after installation.

3.02 ACOUSTICAL PANEL INSTALLATION

- A. Rest acoustical units on flanges of inverted tees with units neatly fitted against abutting surfaces. Fit acoustical units closely and accurately around recessed lighting fixtures, grilles and other fixtures or equipment passing through or in the plane of acoustical finish.
- B. Hold acoustical units in place with a minimum of four hold-down clips per unit at entrances and over partitions. Provide additional hold-down clips where acoustical units do not fit snug to system flanges.

3.03 INSULATION INSTALLATION

- A. Install sound attenuation blankets above ceilings where indicated with all joints butted tightly. Completely cover entire surface with blankets free from wrinkles, sags, tears, ruptures, etc. Lay batts flat in the ceiling without being compressed. Place snug against each other so as to leave no space between batts.

3.04 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.
- B. Do not use toothpaste, baby powder or similar material to disguise blemishes.

END OF SECTION

SECTION 09658
RUBBER BASE AND RUBBER ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes:
 - 1. Topset coved rubber base for installation with surface flooring.
 - 2. Rubber accessories.
- C. Related Sections:
 - 1. Section 09651: Rubber Flooring and Stair Covering.
 - 2. Section 09652: Vinyl Composition Tile.
 - 3. Section 09653: Linoleum Tile.
 - 4. Section 09654: Resilient Sheet Flooring.
 - 5. Section 09681: Carpet.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's published technical data describing materials, construction and recommended installation instructions. Submit technical data and installation instructions for each adhesive material.
- B. Maintenance Instructions: Submit manufacturer's recommendations for maintenance, care and cleaning of base.
- C. Samples: Submit Samples of top set base in each available color. Following color selections, submit Samples, not less than 12 inches long of each selected color and type. Submit pint cans of each type adhesive.
- D. Maintenance Materials: Before Substantial Completion, deliver at least 50 lineal feet and 5 outside corner units of each color of rubber base installed. Deliver the materials in unopened factory containers or in sealed cartons with labels identifying the contents, matching installed materials. Include unopened cans of adhesives adequate to install the maintenance materials.

1.03 QUALITY ASSURANCE

- A. Qualifications of Installer: Minimum 5 years experience in successfully installing the same or similar flooring materials.
- B. Comply with the following as a minimum requirement:
 - 1. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM F 1861: Standard Specification for Resilient Wall Base.
 - 3. California High Performance Schools (CHPS) Low-Emitting Materials Table: Materials submitted for rubber base assemblies must be listed as low emitting on the CHPS website, www.CHPS.net, or must be tested by an independent laboratory to meet CHPS Section 01350. All components of an assembly must meet Section 01350 individually or in an assembly. Rubber assemblies include tile and adhesive.

SECTION 09658
RUBBER BASE AND RUBBER ACCESSORIES

4. All chemically based products such as sealers, primers, fillers, adhesives, etc. must be approved by Owner's Office of Environmental Health and Safety (OEHS).
5. Each selected color and configuration shall be from same dye lot and color.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the Project site in original unopened manufacturer's packaging clearly labeled with manufacturer's name. Store materials at room temperature, but not less than 70 degrees F, for a minimum of 48 hours before installation, unless otherwise indicated in manufacturer's printed instructions.

1.05 PROJECT CONDITIONS

- A. Ventilation and Temperature: Verify areas that are to receive rubber base are ventilated to remove fumes from installation materials, and areas are within temperature range recommended by the various material manufactures for site installation conditions.

1.06 WARRANTY

- A. Manufacturer shall provide a 2 year material warranty.
- B. Installer shall provide a 2 year labor warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Roppe, Pinnacle Rubber Base.
- B. Flexco Company, Wallflower Premium Rubber Wall Base.
- C. Burke Base, Premium Rubber Wall Base
- D. Johnsonite Rubber Wall Base

2.02 MATERIALS

- A. Rubber base: Conform to ASTM F 1861; Group 2, solid (homogeneous); Type 1, TS, (thermoset) vulcanized rubber, Style A, 4 inch high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with jobsite formed outside corners.
- B. Rubber base will be PVC free with the ability to be recycled at the end of cove base life.
- C. Base Adhesive: Water based, low odor type, as recommended by manufacturer of rubber base.

2.03 RUBBER ACCESSORIES

- A. Edge Guards, adapter and transitions, reducers, coved caps and stair nosings.
 1. Provide respective rubber accessories from the entire stock of style and sizes of the manufacturer. Install rubber accessories at dissimilar flooring materials, height to match flooring material by roppe or equal. Color as selected by Architect.
- B. Stair tread and riser one-piece shall be a raised circular vantage design #96 with riser with abrasive nosing 50/51 by roppe or equal. Color as selected by Architect.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate the Work of this section with other sections to provide a level, smooth and clean finish surfaces to receive rubber base.

3.02 EXAMINATION

- A. Field verify dimensions and other conditions affecting the Work of this section before commencing the Work of this section.
- B. Before Work is started, examine surfaces that are to receive rubber base. Deficiencies shall be corrected before starting the Work of this section.

3.03 PREPARATION

- A. Do not start preparation until adjacent concrete floor slabs are at least 90 days old and finish flooring is installed.
- B. Install rubber base when ambient temperature is 70 degrees F. or higher.

3.04 INSTALLATION

- A. Install top set base at all hard floors, including resilient flooring, concrete and wood, carpet and other soft floors, unless otherwise indicated on drawings.
- B. Securely fasten and cement base to backing in long lengths in accordance with manufacturer's recommendations. Lay out lengths so that not less than 18 inches long filler pieces are provided. Assure that top and toe continuously contact the wall and floor, and that all joints are tight. Install jobsite formed outside corners at all offsets. All inside corners shall be coped; wrapped corners are not acceptable.
- C. Use of adhesive gun is prohibited. Apply adhesive directly to substrate using the appropriate notched trowel or spreader according to manufacturer's instructions. Maintain 1/8 inch gap from top of base to prevent adhesive oozing onto adjacent surfaces.
- D. Base and outside corners shall be rolled with a seam roller before adhesive sets.

3.05 CLEANING

- A. Maintain clean base surfaces as installation progresses. Clean rubber base when adhesive is properly cured and remove foreign substances.
- B. Clean adjacent surfaces of adhesive or other defacement. Replace damaged and/or defective Work to the specified condition.

3.06 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

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 - 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, 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.

PART 2: PRODUCTS

2.01 MATERIALS - GENERAL

SECTION 09660
RESILIENT FLOORING

- 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 **80% field color group 20% accent color group..**
- 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 install edge strips at all dissimilar floor transitions shall be 3 mm (1/8") thick, homogeneous 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.

SECTION 09660
RESILIENT FLOORING

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 tile square to room axes.
- 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 09680
CARPETING

PART 1: GENERAL

1.01 DESCRIPTION

- A. Provide carpet and all accessory items necessary to complete carpeting as shown on drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. Specifications are based on Bolyu Commercial Carpet with Nexterra Modular Backing.
- B. Carpet shall pass the DOC-FF-1 Pill Test
- C. Carpet shall not exceed a maximum smoke value of DM = 450 or less when tested in accordance with ASTM E662 (NFPA 258)
- D. Carpet shall comply with Class One requirements, minimum 0.45 watts/cubic centimeter, when tested in accordance with ASTM E-648 (NFPA 253).
- E. The carpet installation contractor shall guarantee, in writing, that they will follow manufacturer's installation procedures and CRI 2011 - Standards for Installation of Commercial Flooring. Flooring contractor will void all warranties and will be responsible if product(s) are not installed accordingly to manufacturers published instructions.
- F. The carpet installation contractor shall guarantee, in writing, against defects in workmanship for a period of two years from the date of installation.
 - 1. Provide manufacturer's Standard 10-Year limited performance guarantee and 10-Year full wear guarantee.
 - 2. The installation contractor shall guarantee to re-lay any carpet that does not provide a straight wrinkle-free appearance and to correct any condition due to faulty installation which may appear within two years of the acceptance of the completed project, including any frayed open or raveled seams.
- G. Installation shall be by skilled carpet mechanics, approved by carpet manufacturer, with minimum five (5) years experience on projects of comparable size.
- H. **Upon completion of the carpet installation, the flooring contractor shall deliver a copy of the Fiber Manufacturer's cleaning and maintenance guidelines to the facility manager. A signed receipt of delivery will be provided to the architect.**

1.03 SUBMITTALS

- A. The carpet manufacturer shall provide written certification that the material(s) shipped to the job site shall meet all specified physical and performance requirements.
- B. **Certification from the Flooring Contractor or Distributor will not be acceptable.** Copies of test reports and corresponding literature shall accompany certification.
 - 1. Upon request submit to Architect duplicate samples, minimum 24" x 24", of each color of carpet selected.
- C. Submit a working layout for each area to be covered, showing location of all seams. Show pattern, color, type of trim and all pertinent installation details.
 - 1. Follow CRI-2011 Installation guidelines for layout.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver in original mill containers with each lot having its register number clearly marked on each carton. Store under cover in dry, well-ventilated spaces--Protect from damage, dirt, stains and moisture.
- B. Coordinate delivery and storage with project construction manager or facility manager.

1.05 JOB CONDITIONS

- A. Coordinate installation sequence and scheduling with project schedule.
- B. In general, no carpet should be installed until all other trades have completed their services. As in many instances, a first class installation can deteriorate as a result of damages caused by those other than the carpet installer.

PART 2: PRODUCTS

2.01 MATERIAL

- A. NO MATERIALS OR PRODUCTS SHALL BE INSTALLED ON THIS PROJECT WHICH CONTAIN ASBESTOS OR ASBESTOS-CONTAINING MATERIALS.
- B. CARPET WILL NOT BE ACCEPTED IF IT DOES NOT PASS CRI GREEN LABEL PLUS INDOOR AIR QUALITY EMISSION STANDARDS
- C. CARPET WILL BE PERFORMANCE TESTED BY FIBER MANUFACTURER OR A CERTIFIED LABORATORY ACCREDIATION PROGRAM.
- D. PRODUCT WARRANTIES: APPROVED PRODUCTS MUST HAVE THE FOLLOWING STANDARD AND NON-PRORATED WARRANTIES:
 - 1. Pile Fiber: 100% Branded Avarar RE Nylon
 - 2. Pile Yarn Weight: [26 oz]
 - 3. Dye Method: 100% Solution Dyed
 - 4. Secondary Backing: Nexterra
 - 5. Machine Gauge: [1/10 in]
 - 6. Stitch Count: [11.0 S.P.I]
 - 7. Density Factor: [6,411]
 - 8. Tile Size: 24" wide x 24" length
 - 9. Static Generation: 3.5 kV or below for the life of the carpet (AATCC 134-79)
 - 10. Stain Resistance: 4 or Better under AATCC Gray Scale
 - 11. Light Fastness: 4 or Better after 8 Cycles (AATCC 16E)
 - 12. Ozone: 4 or Better after 8 Cycles (AATCC 129)
 - 13. Oxides of Nitrogen: 4 or Better after 8 Cycles (AATCC 164)
 - 14. Manufacturer warrants that the carpet will not have continuous ends coming out at lengthwise seams for the life of the carpet.
 - 15. Manufacturer warrants that the carpet will not zipper or develop continuous "pile yarn runs" for the useful life of the carpet.
 - 16. Useful Lifetime Edge Ravel Warranty
 - 17. Useful Lifetime Delamination Warranty
 - 18. Useful Lifetime Run Resistance Warranty
 - 19. Useful Lifetime Colorfast Warranty on all colors.
 - 20. Useful Lifetime Stain Removal Guarantee on all colors
 - 21. Must Qualify for Nationwide Recycling Program.
- E. Approved Carpet:
 - 1. Bolyu Commercial Carpet, Style- "Tie", Tip Sheared Loop Pattern, Color 54, and Color Skinny
 - 2. Bolyu Commercial Carpet, Style-Tie, Tip Sheared Loop Pattern, Color #47, and Color Ascot
- F. Adhesive: Adhesive must be approved by the carpet manufacturer and non-toxic as defined by the federal hazardous substance act, 16 CFR, Section 1500.3 or OSHA Regulation 29 CFR 1910-1200.

- G. Floor Filler: Portland patching compounds and skim coats are porous and must be primed. All fillers must be compatible with adhesive.
- H. Trim Stripes: See Specifications
- I. All Adhesives have to be CRI-Green Label Plus Certified and have ANSI Accreditation. MSDS, CRI-GLP and ANSI Certifications will need to be submitted for LEED Projects.

PART 3: EXECUTION

3.01 INSPECTION

- A. Inspect surface to receive carpet. Notify Architect of any conditions that prevent a satisfactory installation.
- B. The sub-floor receiving the carpet must be properly prepared. Sub-floor must be structurally sound surface of APA approved plywood, hard board, terrazzo and all grades of concrete where moisture and moisture related problems, such as alkalinity do not exist.
- C. Surface must be smooth, clean, dry and free from grease, dirt and other foreign matter, including excessive adhesive residue.
- D. All sub-floors must be tested for moisture, alkalinity and bond. Moisture test should be performed using test protocol ASTM F-1869 or ASTM F-2170 prior to installation to make sure conditions are acceptable for installation of materials.
- E. Whether the carpet is to be installed over new or old construction the surface must be free of cracks and depressions as irregular surfaces could cause excessive wear and telescope through to the surface.
- F. All cracks should be filled using a Portland base leveling or patching compound. Use of latex additive in lieu of water will create better bonding properties.
- G. Should you encounter asbestos containing or other hazardous materials, you should stop the installation immediately and obtain assistance from a qualified remediation consultant prior to continuing the preparation process.
- H. Do not install over resin or silicate based curing compounds. Do not use oil or silicate based sweeping compounds.
- I. Bond tests must be performed over concrete with unidentified sealers or primers. Apply Beaulieu adhesive and tile in a 4 ft. area and let set for 24 hours then check adhesive bond to the floor.

3.02 INSTALLATION

- A. Flooring contractor will use only skilled and experienced carpet installation mechanics.
- B. Install carpet straight, level and true with all piles running in the same direction. Secure to floor in accordance with manufacturer's current written instructions for a direct glue-down installation.
- C. Carpet tiles should not be brought to the job site until the facility (work area) is properly acclimatized, as if it were in use by the building occupants. Ambient site conditions must be between 5-85 F (18-29.5 C), and relative humidity between 40-60%. These conditions must be maintained at least 48 hours before, during, and 72 hours after the installation completion.
- D. Carpet tiles and adhesive must be acclimated to these conditions for a minimum of 48 hours before installation.
- E. Only approved adhesive and trowel notching recommended by the carpet manufacturer will be accepted. A 100% transfer of the floor adhesive into the carpet backing while maintaining full coverage of the floor must be obtained.
- F. Provide trim strips wherever carpeting abuts other types of flooring materials-see finish schedule for details.
- G. Only factory edging should be touching each other in all situations. Cut edges should be placed on outside edge of room.
- H. For cuts or radius in carpet tile, remove all loose pieces of face yarn with sharp seam scissors for a clean and even seam.

- I. The area covered by one application of adhesive shall not exceed the maximum working area recommended by the adhesive manufacturer. The correct open time for adhesive must be strictly adhered to. Open time will vary depending upon environmental conditions.
- J. Trim excess carpet flush to the wall and to other adjacent vertical surfaces.

3.03 ADJUST AND CLEAN

- A. Upon completion of installation, remove all debris; carpet scraps, etc. from surface of carpet. Clean with cylindrical brush vacuum cleaner. Remove any spilled spots or excessive adhesive on carpet with approved adhesive removal solvent. Remove all loose pieces of face yarn with sharp seam scissors.
- B. Upon completion of installation, the work shall be inspected by the Contractor and the Architect for color side match, frayed or cut edges, use of trowel for application of adhesive and complete adhesion.
 - 1. Flooring Contractor shall correct, replace or re-lay any carpet which does not run straight and which does not provide an attractive wrinkle free appearance.
 - 2. Replace areas of carpet where material on each side of a seam do not side match in color.
- C. The Owner shall be permitted to inspect and retain waste carpet for future repairs, before they are removed from the job site.
- D. After completion, flooring contractor must make available, three (3) – 9" x 9" of each actual installed product(s) to the architect.

3.04 PROTECTION

- A. After installation is complete, protect carpet surface from damage and staining until acceptance and occupancy by the Owner.
- B. Cover traffic areas with craft paper or other means until submittal completion.
 - 1. **Plastic sheeting should not be used over glue-down installation as it may trap moisture, thus preventing the proper curing of the adhesive.**
 - 2. Protect the installation from rolling traffic by using sheets of hardboard, or plywood in affected areas.
- C. Traffic over adhesive installation should be restricted for a minimum of 24-48 hours to allow proper adhesive cure. Premature traffic can cause installation failure.
 - 1. **Exposure to water from cleaning and other sources must be restricted for a minimum of 30 days.**
 - 2. Flooring contractor must provide a copy of the adhesive application guidelines to the architect including a MSDS report or displays CRI Green Label on each adhesive and cleanup solvent to be used on the project.
- D. Temperatures of indoor carpeted areas must never fall below 50°F regardless of the age of the installation.

3.05 FIELD QUALITY REQUIREMENTS

- A. Manufacturer's Field Services: Upon owner's request and within minimum 72 hours notice, provide manufacturer's field service consisting of product use recommendations and periodic site visits to confirm installation of product is in accordance with the manufacturer's instructions.
 - 1. Site Visits: [Specify number and duration of periodic site visits]

END OF SECTION

SECTION 09900
PAINTING

PART 1: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Finish Painting 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. Paint to completion of all exposed surfaces throughout the Project, both interior and exterior with the exception of the following:
 - 1. Surfaces which are delivered to the job site with a factory finish, unless indicated to be painted.
 - 2. Nonferrous metals.
 - 3. Integral color Concrete, Stucco or Cementitious Coatings.
 - 4. Exposed concrete floors.
 - 5. Face brick.

1.02 SUBMITTALS

- A. Detailed Painting Schedule
 - 1. Furnish a "Detailed Painting Schedule" for approval by the Architect. Indicate type of surface, type of paint material, and number of coats required, as set forth in the "Painting Requirements" hereinafter specified.
 - 2. Submit brand designation and grade of the indicated type produced by the approved manufacturer for each application listed or required.
 - 3. Submit product analyses and performance characteristics for all paint materials as requested by the Architect.
 - 4. Submit approval of the "Detailed Painting Schedule" before delivering material to the job site.
 - 5. No claim by the Painting Contractor as to the unsuitability or unavailability of any material specified or his unwillingness to use same or his inability to produce first-class work with same will be entertained, unless such claims are made in writing and submitted with his bid.
 - 6. The Architect will check the "Detailed Painting Schedule" and if any painting material listed therein does not represent, in the opinion of the Architect, such highest quality of the manufacturer, the Architect may direct its replacement with an acceptable painting material at no additional cost to the Owner.
 - 7. Owners maintenance manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.
- B. Samples
 - 1. Submit duplicate samples of each type paint finish proposed for use.
 - 2. Samples shall be 3"x6" on suitable materials and shall be as true a representation of finished work as is practicable.
 - 3. Label each sample and show various stages of finish on each sample.

1.03 PRODUCT HANDLING

- A. Delivery
 - 1. Deliver material to job site in original, unopened containers and packages bearing manufacturers name, type of paint, stock number and color.
 - 2. Deliver all paints ready-mixed unless otherwise directed by the Architect.
- B. Storage
 - 1. Keep storage area neat, clean and adequately protected from paint spillage. Repair damage caused to surfaces within storage areas.
 - 2. Dispose of all cloths and cotton waste which might constitute a fire hazard at the end of each work day.

1.04 ENVIRONMENTAL CONDITIONS

- A. Do not apply paint or varnish under conditions that could adversely affect drying of final finish. Apply all materials under adequate illumination and ventilation.
- B. Do not apply paint or varnish when temperature is less than 50 deg. F. or more than 90 deg. F., or when excess humidity is present.

1.05 PROTECTION

- A. Protect or remove hardware, escutcheons, fixtures, plates, covers, and other items subject to damage or discoloration from painting.
- B. Carefully and adequately protect, as required, all surfaces not requiring painting in areas where painting is being carried on. Use tarpaulins or other suitable covers, with supports, if needed, to protect adjacent or underlying surfaces
- C. Maintain all wrappings or other factory-applied protection furnished with finishing hardware or other items provided by other trades and installed in areas where painting is required. If wrappings are displaced or removed, protect surfaces for the duration of painting work.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Material manufactured by The Sherwin Williams Company is the acceptable standard of quality. Coating systems from other listed manufacturers shall match the systems specified provided it complies with the Contract Documents.
 - 1. PAINT:
Sherwin-Williams Company
Pratt and Lambert, Inc.
PPG Paints
Benjamin Moore

2.02 MATERIALS

- A. PREPARED PAINTS AND COATINGS: All by the same manufacturer, unless otherwise specified.
- B. TINTING COLORS: By manufacturer of Prepared Paint.
- C. SPACKLING COMPOUND: Finely ground, grit-free when dry will set with no shrinkage to a smooth, hard, white surface and will sand properly and receive any finish.
- D. PATCHING PLASTER: White, nonshrinking, containing no lime and uniform in set and quality.
- E. TAPE AND BED MATERIALS:
 - 1. JOINT TAPE: USF Perf-A-Tape
 - 2. EMBEDDING AND FINISHING COMPOUND: USG Ready-Mixed Joint Compound All Purpose.
- F. PRIMERS:
 - 1. FERROUS METAL PRIMER: Sherwin Williams Pro-Cryl Universal Water Based Primer B66-310.
PPG Paints: Pitt-tech Plus Int/Ext DTM Primer/Finish 90-912
 - 2. ALKYD ENAMEL PRIMER: Sherwin Williams Pro-Cryl Universal Water Based Primer B66-310.
PPG Paints: 4160 Devguard DTM Primer
 - 3. ALKYD WOOD PRIMER: Sherwin Williams Premium Wall and Wood Primer B28W8111.
PPG Paints: Seal Grip Universal Int/Ext Alkyd Primer 6-14
 - 4. LATEX WALL PAINT PRIMER: Sherwin Williams Prep Rite High Build Primer B28W8601 with
texture to produce fine finish plaster appearance on Drywall.
PPG Paints: Pure Performance Latex Primer, 9-900, 0g/LVOC
 - 5. SPOT PRIMER: Sherwin Williams Pro-Cryl Universal Water Based Primer B66-310.
PPG Paints: Pitt-tech Plus Int/Ext DTM Primer/Finish 90-912
 - 6. GALVANIZED PRIMER: Sherwin Williams Pro-Cryl Universal Water Based Primer B66-310.
PPG Paints: Pitt-tech Plus Int/Ext DTM Primer/Finish 90-912
 - 7. WATERPROOF EXTERIOR PRIMER/FINISH: Sherwin Williams Loxon XP.
PPG Paints: Perma-Crete Int/Ext Alkali Resistant Primer 4-603
- G. FILLERS/SEALERS:
 - 1. WOOD FILLER: Sherwin Williams Wood Filler.
 - 2. KNOT SEALER: Formula WP0578 of the Western Pine Association.
- H. HIGH PERFORMANCE PAINTS:
 - 1. SEMIGLOSS ENAMEL: Sherwin Williams Pro Industrial Pre-Catalyzed Epoxy Semi-Gloss
K46W151
PPG Paints: Pitt Glaze Pre-Catalized Epoxy Semi-Gloss 16-510
- I. LATEX PAINTS:
 - 1. LATEX FLAT WALL PAINT: Sherwin Williams Pro Mar 200, Antimicrobial, Zero VOC, Latex
Finish, Flat, Egg-Shell and Semi-Gloss.
PPG Paints: Pure Performance
 - 2. LATEX MASONRY PAINT, ACRYLIC: Sherwin Williams Loxon XP.
PPG Paints: Perma-Crete High Build 100% Acrylic
 - 3. VINYL LATEX EMULSION: Sher-Tex medium texture.
PPG Paints: Perma-Crete Textured Coatings

- J. LACQUER: Fed. Spec. TTP-P-143.
- K. WOOD STAIN: Sherwin Williams Semi-Transparent Polyurethane Exterior Stain A15T5.
PPG Paints: Flood Semi-Transparent Polyurethane Stain
- L. WOOD STAIN: Sherwin Williams Woodscapes Solid Color Acrylic House Stain A15 Series.
PPG Paints: Flood Acrylic Solid Color Stains
- M. OIL: Watco Danish Oil
- M. WAX: Watco Satin Carnauba Liquid Wax
- O. (1) INTERIOR EPOXY: One (1) coat Sherwin Williams Heavy Duty block-filler; then Sherwin Williams Pro Industrial Water Based Epoxy B73 Series.
PPG Paints: Speedhide 6-15 Hi Fill Block Filler, finish coat: Pitt-Glaze 16-551 series
- P. EXTERIOR Elastomeric: Sherwin Williams two (2) coats Loxon XP Waterproofing System
PPG Paints: 2 Coats Decra Flex 300 Smooth Flat 2260
- Q. FIRE RETARDANT PAINT: Sherwin Williams: Flame Control No. 20-20 interior fire retardant flat latex, shall be used on all exposed painted wood except doors and millwork.

2.03 MIXING:

- A. Tint prime coats and undercoats approximately to the shade of the final coat, but each with a slight variation in color to distinguish them from the preceding coat.
- B. Apply paint of consistency recommended by manufacturer. Additional thinning permitted only with specified approval.
- C. Use factory mixed colors, shades, and tints with finish paints matching the approved color samples. Job mixing permitted only with specific approval.

2.04 FINISH AND COLORS:

- A. Paint colors shall be as selected by the Architect. Before any work is begun, the Architect will furnish the Painting Contractor with a color schedule and/or chips showing where the **various** colors shall be used.
- B. ***60% of wall paint shall cover field wall and accent walls and surfaces terminating at corners floor and ceilings, 40% of wall paint shall be accent stripping, wall patterns, logo or graphics as selected by architect.***

PART 3: EXECUTION

3.01 CONDITION OF SURFACES

- A. Examine surfaces to receive painting before beginning work and correct defects that could affect quality of finished work. Prepare surfaces, as necessary, to receive painting as specified. Retouch shop coats and prime coats as necessary.
- B. Starting painting work shall be construed as evidence of acceptance of conditions under which work will be done.

- C. Clean surfaces to be painted and spaces in which painting will be done, broom-clean and dust-free. Remove soil, prints, stains, and adhered materials that would affect finish painting.
- D. If acids have been used for cleaning, all traces of acid shall be thoroughly neutralized and rinsed and dried before any paint is applied.
- E. Meet requirements of other portions of specifications for preparation of specific items.
- F. Apply primer or first coat immediately after surface preparation to prevent contamination of the surface.

3.02 PREPARATION

A. Shop Painted Ferrous Metal

- 1. Clean surfaces free of concrete, mortar, plaster, rust, shavings, dirt, dust and other objectionable materials. Remove grease and oil with gasoline, benzine or other similar volatile cleaner. Use cleaner when space is properly ventilated and not in the presence of any open flame.
- 2. Touch up abraded or marred shop coats with spot primer specified.

B. Unpainted Ferrous Metal

- 1. Clean surfaces free of loose scale, rust, shavings, filings, dirt, dust and other objectionable material with wire brushes or other proper and acceptable means.
- 2. Remove grease and oil with gasoline, benzine or other similar volatile cleaner. Sandblast or wire brush to base metal all rusted areas on exposed exterior members. Use cleaner when space is properly ventilated and not in the presence of any open flame.

C. Zinc-Coated Metal (Galvanized)

- 1. Clean surfaces free of loose particles and other objectionable material. Remove grease and oil with mineral spirits or other similar cleaner.
- 2. Coat welded, chipped or abraded surfaces with "Galvalloy" galvanizing stick compound or ZRC Zinc Coating after wire brush cleaning.
- 3. Treat surfaces with an approved chemical compound such as a phosphoric acid-wash. Remove chemical compound completely with clean, fresh water and thoroughly dry surfaces prior to priming.

D. Gypsum Board

- 1. Mix and apply tape and bedding system in accordance with the manufacturer's recommendations.
- 2. Apply joint compound (embedding coat) to internal angles and butt joints approximately 3" wide and sufficiently thick to hide board surfaces. Cover screw heads and depressions with compound.
- 3. Apply tape to angles and joints, centered and seated into compound leaving sufficient compound under tape to provide proper bond. Apply a skim coat of compound over tape and clean excess compound from wallboard surface.
- 4. When first coat has thoroughly dried, apply second coat (fill coat) over embedding coat, filling board taper flush with board surface. For joints without taper, feather out 4" on either side of tape.
- 5. When second coat has thoroughly dried, apply third coat (finishing coat) tapered beyond edges of second coat and feathered to a smooth uniform finish which does not protrude beyond the plane of the board surface.
- 6. Apply at least two coats of compound to flanges of corner beads and metal edging. Extend compound approximately 8 to 10 inches either side of exposed metal. Apply three coats of compound in

- succession for all dimples at fastener heads
7. Sand all coats after each application has dried and leave wallboard and treated areas uniformly smooth, ready to receive decoration.
- E. Plaster: **shall be painted as described in this specification. Color as selected by architect.**
- F. Wood
1. Clean knots, pitch streaks or visible sap spots free of residue and treat with Knot Sealer. Apply second coat of sealer no less than two hours after the application of the first coat.
 2. Fill nail holes and other indentations with wood filler after first coat, matching color of stain or paint. Finish flush with adjacent surfaces.
 3. Sand wood surfaces smooth with No. 00 sand paper and remove dust prior to painting.
- G. Factory Finished Items
1. Factory finished items requiring painting shall be etched or otherwise prepared in an approved manner to receive final finish coat.
- H. Insulation
1. Clean surfaces of pipe, duct and equipment insulation, such as canvas jackets and troweled-on insulation and of rigid wall or ceiling insulation where items are required to be painted.
 2. Remove all loose, foreign and objectionable material prior to the application of any paint materials.
- I. Copper Piping
1. Wash surfaces with a 5 percent acetic acid solution and allow to dry. Do not damage adjacent surfaces due to acid spillage.
- J. Aluminum: Prefinished (or anodized) aluminum shall not be painted.
1. Remove oil or grease film by washing surfaces with mineral spirits or turpentine. Allow new, bare aluminum to weather for a month or roughen with steel wool before painting.

3.03 APPLICATION

- A. Do not open containers until required for use. Thoroughly mix paint before application and frequently stir during application so as to maintain pigment satisfactorily in suspension.
- B. Do not thin paint in excess of the printed directions of the manufacturer. Do not allow caking or setting of pigment into a hard mass.
- C. Apply paint uniformly without visible laps, sags, curtains, holidays or objectionable brushmarks. Exercise care so that paint does not splatter on surfaces not required to be painted. Remove promptly paint applied or splattered on surfaces not required to be painted.
- D. Insure that all primer and intermediate coats of paint are unscarred and completely integral at the time of application of each succeeding coat. Allow sufficient time between coats to ensure proper drying.
- E. Sand between all coats on wood and-metal surfaces prior to the application of succeeding coats.

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PAINTING

- F. Remove doors for painting tops and bottoms. Finish top and bottom edges of doors the same as faces, after fitting.
- G. Match final coat of paint in color, tint and hue with the color displays approved by the Architect.
- H. Paint edges of doors occurring between rooms or spaces having different finishes the same as the room or space from which the same are visible when the door is in a partly opened position.
- I. Paint factory finished access panels, registers, grilles, diffusers, electrical panel boxes, connector covers and similar items the same color as adjoining walls or ceilings. Use color as directed where adjacent surfaces do not require painting.
- J. Finish all closets the same as the adjoining rooms, unless otherwise specified. Finish all other surfaces the same as nearest or adjoining surfaces unless otherwise shown.
- K. Paint exposed insulated and non-insulated piping, conduits, duct work and hangers a color and texture to match walls or ceilings adjacent to it. Where adjacent surfaces are unpainted, use color as directed.
- L. Back-prime all interior wood trim before installation, with alkyd primer or Okene Preservative.
- M. Protect all accent colors on walls with a coating of pale varnish as approved by the Architect.
- N. Application of Oil Finish:
 - 1. Apply Watco oil for saturated coat with brush or rag. Let set 30 minutes. Repeat procedure and let set 5 to 10 minutes. Wipe off excess with clean dry rag.
 - 2. Let set overnight. Repeat entire procedure.
 - 3. Let set overnight. Sand with light sandpaper. Apply coat of liquid wax and buff with clean dry rag.
 - 4. Match sample in Architect's office.

3.04 FIELD QUALITY CONTROL

- A. When painting is to be started, the manufacturer whose materials have been approved for use shall furnish competent technical assistance on the job to ensure that his materials are being applied properly. Manufacturer's assistance shall be available at all times until completion of the work.
- B. Each coat must be inspected and approved before application of the succeeding specified coat, otherwise no credit for the coat applied will be given and the Contractor automatically assumes the responsibility to recoat the work in question.
- C. Application equipment shall be cleaned a minimum of daily and no work shall be done with equipment which leaves adulterants in the coat of paint being applied.

3.05 CLEANING

- A. Remove from the premises upon completion of the work all staging, scaffolding and containers.
- B. Remove misplaced paint spots, oil or stains upon adjacent surfaces and leave the entire work in a clean condition. Touch up and restore finish where damaged.

3.06 PAINTING SCHEDULE

- A. **EXTERIOR WORK**

1. Iron and Steel
 - 1st coat Sherwin Williams Pro-Cryl Universal Metal Primer
PPG Paints: Devguard 4160 DTM Primer
 - 2nd coat Sherwin Williams DTM Acrylic Semi-Gloss
PPG Paints: Devflex 4216 Semi-Gloss (Maintenance)
 - 3rd coat Sherwin Williams DTM Acrylic Semi-Gloss
PPG Paints: Devflex 4216 Semi-Gloss
2. Galvanized Iron and Steel
 - 1st coat Sherwin Williams Pro-Cryl Universal Metal Primer
PPG Paints: Devguard 4160 DTM Primer
 - 2nd coat Sherwin Williams DTM Acrylic Semi-Gloss
PPG Paints: Devflex 4216 Semi-Gloss (Maintenance)
 - 3rd coat Sherwin Williams DTM Acrylic Semi-Gloss
PPG Paints: Devflex 4216 Semi-Gloss
3. Machinery and Equipment.
 - Spot Prime Sherwin Williams Pro-Cryl Universal Metal Primer
PPG Paints: Devguard 4160 DTM Primer
 - 2nd Coat Sherwin Williams Pro Industrial Multi-Surface Acrylic
B66W1501 Gloss
PPG Paints: Pitt Tech 90-1210
4. Exterior CMU
 - 1 coat Sherwin Williams Loxon Block Surfacers A24W200
PPG Paints: Perma-Crete Concrete Block & Masonry Surfacers 4-100XI
 - 2 coats Sherwin Williams Loxon XP Elastomeric Waterproofing System,
A24-1400 Series
PPG Paints: Decra Flex 300 Elastomeric 2260
5. Exterior Masonry Sherwin Williams Pro Industrial Anti-Graffiti Coating Clear, B97C150
Blok-Guard & Graffiti Control by Prosoco Clear
PPG Paints: See rep for sacrificial and non sacrificial
6. Exterior Stucco
 - 2 Coats Sherwin Williams Self Cleaning Acrylic Flat LX13W51
PPG Paints: Manor Hall

B. INTERIOR WORK

1. Miscellaneous Iron and Steel
 - 1st coat Sherwin Williams Pro-Cryl Universal Metal Primer
PPG Paints: Devguard 4160 DTM Primer
 - 2nd coat Sherwin Williams Pro Industrial Multi-Surface Acrylic Semi-Gloss
B66W1551
PPG Paints: Devflex 4216 Semi Gloss
 - 3rd coat Sherwin Williams Pro Industrial Multi-Surface Acrylic Semi-Gloss
B66W1551
PPG Paints: Devflex 4216 Semi Gloss
2. Primer Miscellaneous Iron and Steel spot prime

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PAINTING

		Sherwin Williams Pro-Cryl Universal Metal Primer PPG Paints: Devguard 4160 DTM Primer
	1st coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic Semi-Gloss B66W1551
	2nd coat	PPG Paints: Deviflex 4216 Semi Gloss Sherwin Williams Pro Industrial Multi-Surface Acrylic PPG Paints: Devflex 4216 Semi Gloss
3.	Galvanized Iron and Steel	
	1st coat	Sherwin Williams Pro-Cryl Universal Metal Primer PPG Paints: Devguard 4160 DTM Primer
	2nd coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic B66W1551 PPG Paints: Devflex 4216 Semi Gloss
	3rd coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic B66W1551 PPG Paints: Devflex 4216 Semi Gloss
4.	Bonderized Steel	
	1st coat	Sherwin Williams Pro-Cryl Universal Metal Primer PPG Paints: Devguard 4160 DTM Primer
	2nd coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic B66W1551 PPG Paints: Devflex 4216 Semi Gloss
	3rd coat	Sherwin Williams Pro Industrial Multi-Surface Acrylic B66W1551 PPG Paints: Devflex 4216 Semi Gloss
5.	Gypsum Drywall	
	1st coat	Sherwin Williams Prep Rite Hi-Build Primer B28W8601 PPG Paints: Pure Performance latex primer 9-900
	2nd coat	Sherwin Williams Pro Mar 200 Zero VOC Latex Egg-Shell B20W12651 PPG Paints: Pure Performance egg shell 9-300
	3rd coat	Sherwin Williams Pro Mar 200 Zero VOC Latex Egg-shell B20W12651 PPG Paints: Pure Performance egg shell 9-300
6.	Gypsum Drywall (High Traffic Areas, Hallways, Wet areas & Stairwells)	
	1st coat	Sherwin Williams Prep Rite Hi-Build Primer B28W8601 PPG Paints: Pure Performance latex Primer 9-900
	2nd coat	Sherwin Williams Pro Industrial Pre-Catalyzed Epoxy Egg-Shell, Semi-Gloss K46-W151 PPG Paints: Pitt-Tech Glaze Pre-Catalyzed Epoxy 16-310,93 g/L VOC Egg-Shell, Semi-Gloss
	3rd coat	Sherwin Williams Pro Industrial Pre-Catalyzed Epoxy Egg-Shell, Semi-Gloss K46-W151 PPG Paints: Pitt-Tech Glaze Pre-Catalyzed Epoxy 16-310,93 g/L VOC Egg-Shell, Semi-Gloss
7.	Portland Cement Plaster & Stucco (that is not integral color)	
	1st coat	Sherwin Williams Prep Rite Masonry Primer PPG Paints: Seal Grip Int/Ext Acrylic Primer 17-921
	2nd coat	Sherwin Williams Pro Mar 200 Zero VOC Latex Egg-Shell B20W2600 PPG Paints: Speedhide zero Interior Eggshell 4-4310XI
	3rd coat	Sherwin Williams Pro Mar 200 Zero VOC Latex Egg-Shell B20W2600 PPG Paints: Speedhide zero Interior Eggshell 4-4310XI
8.	Wood Surfaces (Natural Finish)	

SECTION 09900
PAINTING

	1st coat	Oil
	2nd coat	Oil
	3rd coat	Oil
	4th coat	Wax
9. Wood Surfaces (Stained)
- | | | |
|--|----------|--------------------------------|
| | 1st coat | Stain |
| | 2nd coat | Filler (open grain wood, only) |
| | 3rd coat | Lacquer Sanding Sealer |
| | 4th coat | Dull Rubbed Lacquer |
| | 5th coat | Dull Rubbed Lacquer |
10. Machinery and Equipment
- | | | |
|--|------------|---|
| | Spot Prime | Sherwin Williams Pro-Cryl Primer
PPG Paints: Devguard 4160 DTM Primer |
| | 2nd Coat | Sherwin Williams Pro Industrial Multi-Surface Acrylic Gloss
PPG Paints: Dev Flex 4216 Semi Gloss |
11. Exposed Canvas Covered Piping
- | | | |
|--|----------|---|
| | 1st coat | Sherwin Williams Drywall Latex Primer B28W8100
PPG Paints: Speedhide Interior Latex Sealer 6-2 |
| | 2nd coat | To match paint specified for |
| | 3rd coat | coats adjoining surfaces |
12. Exposed Rigid Insulation
- | | | |
|--|----------|--|
| | 1st coat | Primer as recommended by the manufacturer of the finish coats
XIM, UMA 400 Bonding Primer |
| | 2nd coat | Sherwin Williams Multi-Surface Acrylic Egg-Shell B666W1561
PPG Paints: Dev Flex 4216 Semi Gloss |
13. Exposed-High: Temperature Metal Piping
- | | | |
|--|----------|--|
| | 1st coat | Sherwin Williams Kem Hi Temp Heat Resistant Paint
PPG Paints: High Heat Paint |
| | 2nd coat | Sherwin Williams Kem Hi Temp Heat Resistant Paint
PPG Paints: High Heat Paint |
14. CMU
- | | | |
|--|----------|---|
| | 1st coat | Sherwin Williams Heavy Duty Block Filler or Loxon Block Surfacers
PPG Paints: Speedhide Int/Ext Masonry Hi Fill Block Filler |
| | 2nd coat | Sherwin Williams Pro Mar 200 Zero VOC, Latex Semi-Gloss,
B31W2651
PPG Paints: Aquapon Water Based Epoxy 98 Series, 325g/L VOC |
| | 3rd coat | Sherwin Williams Pro Mar 200 Zero VOC, Latex Semi-Gloss,
B31W2651
PPG Paints: Aquapon Water Based Epoxy 98 Series, 325g/L VOC |
15. CMU (High Traffic Areas, Hallways, Wet areas & Stairwells)

1st coat	Sherwin Williams Loxon Block Surfacers PPG Paints: Speedhide Int/Ext Masonry Hi Fill Block Filler
2nd coat	Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy B73-300 Series PPG Paints: Aquapon Water Based Epoxy 98 Series, 325g/L VOC
3rd coat	Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy B73-300 Series PPG Paints: Aquapon Water Based Epoxy 98 Series, 325g/L VOC
16. Where indicated on drawings interior concrete floors shall be trowel smooth finish and shall be etched with 10% muriatic acid, flush with water and allowed to dry thoroughly.
- | | |
|----------|---|
| 1st coat | Sherwin Williams solvent base H & C Concrete Stain & Sealer: Clear or Colored as selected by architect |
| 2nd coat | Sherwin Williams solvent base H & C Concrete Stain & Sealer: Clear or Colored as selected by architect Sealer |
| 3rd coat | Sherwin Williams solvent base H & C Concrete Stain & Sealer: Clear or Colored as selected by architect Sealer provide Anti-slip grit on the final coat. |
17. Exposed Structural Steel
- | | |
|-------------|--|
| 1 – 2 coats | Sherwin Williams Low VOC Waterborne Acrylic Dryfall B42 Series
PPG Paints: Speedhide Super Tech Interior Dry-Fog Flat Latex 6-723XI |
|-------------|--|

3.07 PIPE IDENTIFICATION

- A. Conform to requirements of ASA A13, "Scheme for the Identification of Pipe Systems," as published by the American Society of Mechanical Engineers. Provide complete painting of piping in mechanical rooms only.
- B. Color Coding:
1. Domestic Water, Cold or Hot – Green SW4085
 2. Chilled, Heating or Condenser - Water - Green SW4085
 3. Gas - Orange SW4083
 4. Air - White SW4087
 5. Condensate - Black SW4090
 6. Electric Conduit - Yellow SW4084
 7. Oil - Orange SW4083
 8. Drain Lines - Black SW4090
 9. Steam - Orange SW4083
 10. Fire Protection Sprinkler – Red SW4081

3.08 SMOKE AND FIRE WALLS

- A. Contractor shall identify all one-hour smoke walls and horizontal exit walls, by painting with stencil on both sides of wall, the rating which applies to the wall, Identifications shall be 11'-0" above finish floor, or above finish ceiling where wall does not extend above 11'-0", and shall be spaced at maximum distance of 29'-0" o.c. Height of letters shall be 4". Color of paint for letters will be Black.

END OF SECTION

SECTION 10155
PLASTIC LAMINATE TOILET COMPARTMENTS

PART I: GENERAL

1.01 SCOPE

- A. Perform all work required to complete the Toilet Compartments 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 apply to all work required for this section.

1.02 SUBMITTALS

- A. Shop Drawings
 - 1. Show locations, sizes, quantities, door swings, methods of supporting, methods of anchoring, markings, finishes and operating hardware.
- B. Samples
 - 1. Submit sample corner of typical door panel showing details of construction and finish. Submit samples of all hardware.
 - 2. Submit samples of standard colors for color selection.

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.
 - Ampco Products, Inc.
 - Global Steel Products Corp.
 - American Sanitary Partition Corporation
 - Bobrick

2.02 MATERIAL

- A. TYPE: Similar to Global "EMBASSY"; floor mounted, overhead braced.
- B. PARTITIONS: 1" thick high pressure plastic laminated bonded to particle board.
- C. DOORS: Same materials as partitions.
- D. FLOOR MOUNTED PILASTERS: 1-1/4" thick plastic-laminate covered.
- E. PLINTH: No. 4 satin stainless steel.

2.03 FABRICATION

SECTION 10155
PLASTIC LAMINATE TOILET COMPARTMENTS

A. Doors and Partitions

1. Construct doors and partitions 1" thick with two sheets of plastic laminate assembled over and cemented under pressure to rigid core.

B. Floor Mounted Pilasters

1. Construction pilasters 1-1/4 inch thick from two sheets of plastic laminate. Finish as specified for partitions and doors.
2. Provide a jack leveling screw at the bottom of pilasters to carry the weight of the compartment and to provide a secure mechanical anchorage to the floor with adjustable floor fittings.

C. Headrail

1. Continuous extruded aluminum, anti-grip profile, with clear satin anodized aluminum finish. Hold headrail in place inside top of pilaster with screw applied through the pilaster into the headrail on the inside of the stall.
2. Extend headrail full length of installation and over end compartments. Fasten headrail into wall brackets and cap exposed ends.

D. Hardware and Fittings

1. Attach dividing partitions and pilasters to one another and to the wall with full height brackets made of heat-treated and anodized extruded aluminum alloy.
2. Conceal attachment of pilaster with a one-piece 3" high polished, stainless steel trim, made theft-proof by securing in place with concealed spring anchor clips without the use of exposed screws.
3. Equip door with concealed, controlled gravity type hinges, mounted on upper and lower hinge pilaster brackets of heat-treated high tensile cast aluminum alloy, factory-mounted on the pilaster in position.
4. Recess top hinge pivot door bracket into edge of door approximately 2" below top with a stainless steel pivot pin mounted within the door structure, supported both above and below the pivot bracket.
5. Carry door weight on a thrust bearing fixed in place by stationary vertical pintle concealed within the door structure. Control door operation by opposing Zytel cams mounted on the fixed vertical pintle.
6. Provide adjustable hinge to permit the door to rest at any angle, or to hold the door open or closed when not latched. Make all moving parts self lubricating and completely concealed within the 1" thickness of the door. Provide top and bottom door hinge castings of heavy, one-piece cast nonferrous alloy.
7. Equip doors with a cast alloy chrome-plate coat hook and bumper, applied with one-way head screws; and a concealed latch, with face mortised flush with edging strip. Make all working parts completely concealed within the thickness of the door.
8. Make latch bolts of stainless steel and exposed escutcheon plate and handle of polished chrome-plated cast alloy nonferrous metal.
9. Provide a one-piece, heavy cast, nonferrous alloy stop and keeper with a polished chrome-plated finish and rubber bumper locked in place. Stop and keeper to be thru-bolted with one-way head, sex

bolts to the pilasters.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Erect partition plumb, square and true with walls and adjoining trim; true to line and level, in accordance with the drawings and approved setting diagrams. Rigidly secure each unit to surfaces and each adjoining part or member in a manner to render the work permanently secure in precise location.
- B. Neatly install hardware and accessories with necessary fastenings matching the specified finish. Adjust all operating parts and set hinges properly for door wing to remain slightly open when compartment is not occupied.
- C. Adequately protect during erection against damage of every nature and finish free from scratches, dents, permanent discolorations and other defects in workmanship or material.
- D. Plastic laminate compartments are to be installed in all Staff and Student Toilets as indicated on plans.

3.02 CLEANING:

- A. Remove all manufacturer's temporary labels or marks of identification and wash surfaces thoroughly clean of oil, grease and foreign material.
- B. Clean and polish plated surfaces and leave entire work in a neat, orderly, clean and acceptable condition approved by the Architect.

END OF SECTION

SECTION 10420
BUILDING PLAQUE 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. SOUTHWELL COMPANY, ARK RAMOS, or approved equal.

2.02 MATERIALS:

- A. Plaque:
 - 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 and graphic logo; shall have those names: ***of the County Commissioners, County Administrator, the Architects, Contractor and 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. Exterior: Cast letters shall be those manufactured by the A.R.K. RAMOS, or approved equal . Letters shall be **ninety {90}** 10" high letters. Contact architect for wording required. Style shall be TIMES ROMAN NO. 528, capital letters.
- B. Interior: Cast letters shall be those manufactured by the A.R.K. RAMOS, or approved equal . Letters shall be **eighty {80}** 10" high letters. Contact architect for wording required. Style shall be TIMES ROMAN NO. 528, 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 F-3*", 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. *At each door, cased opening found on door schedule and room schedule provide 8" x 2" ADA 82NS, for names or numbers. Wall mounted on strike side of door 60" to center line. A.F.F. strike side of door.*
 - 2. *At each restroom provide 6" x 8" ADA restroom signs No. SS7 and SS4 as applicable. Wall mounted on strike side of door 60" to the center line A.F.F.*
- 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.

SECTION 10441
IDENTIFICATION SIGNAGE

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: Largest size applicable to number of characters and size of plate with Braille below or to side.
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) refer to drawings for quantities.***
- 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 Rated Cabinet – EX OPTION. Provide wall bracket where indicated on drawings.***
- C. Require number of extinguishers and 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. Provide engineering reactions for foundation requirements.
- 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 assure 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. AVAdek walkway cover systems and canopies submitted, 9201 Winkler Drive, Houston, Texas 77017, 713-944-0988.
- B. East Texas Canopy, Inc.
- C. Superior Metal Products Company, Inc.
- D. Peachtree Protective Covers.
- E. Bowman Distributing Company.
- F. Perfection Architectural Systems.

2.2 COMPONENTS

SECTION 10530
EXTRUDED ALUMINUM CANOPIES

- 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. ***(Types of canopies over doors shall be OH Beam-01, and custom entrance canopies as indicated on Drawings.)***
- C. FINISHES
Deck: *Kynar, custom color to be selected by Architect*
Trim: *Kynar, custom color to be selected by Architect*
Beams: *Kynar, custom color to be selected by Architect*
Columns: *Kynar, custom 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 raincaps 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 10800
TOILET ROOM ACCESSORIES

PART 1 - GENERAL:

1.1 SCOPE:

- A. Perform all work required to complete the Toilet Room Accessories 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 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

2.1 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. ACCESSORIES
 - The Bradley Corporation
 - AJW Architectural Products
 - Bobrick Washroom Equipment
 - American Specialties, Inc.

2.2 MATERIALS:

(Schedule of Accessories - BOBRICK numbers are used herein).

- A. *At each Water Closet: Contractor shall install & furnish toilet tissue dispenser #B-274.*
- B. *At each room marked "CUSTODIAN" or "JANITOR" (located above service sink) provide and install one {1} B-223 stainless steel mop and broom holder.*
- C. *At each lavatory or sink furnish & install surface mounted soap dispenser #B-5050.*
- D. *At each handicapped Water Closet and handicap showers:*
 - 1) *Grab Bars:*
 - a) *Provide and install BOBRICK, or approved equal, B-610x48", 42", 36", or 24" x 1½" Ø stainless steel grab bars. Bars shall be mounted as indicated on the Drawings, parallel to finish floor, exactly 1½" clearance from wall to inside of bar. Bar surface shall be peened. Refer to Drawings for locations and sizes.*
 - b) *Bars shall be manufactured and installed in complete compliance with State of Texas Senate Bill No. 111-61st Legis. as amended by H.B. 1319 - 62nd Legis. and S.B. 613 - 63rd Legis.*
- F. *At each lavatory or sink furnish & install a Paper Towel Dispensers BOBRICK #B-359*

- G. At each lavatory or sink furnish & install a Waste Receptacles BOBRICK #B-3644.***

PART 3: EXECUTION

3.1 INSTALLATION:

- A. Install accessories according to manufacturer's instructions and approved shop drawings. Install accessories plumb, square, level and true with wall or surfaces. Install grab bars where scheduled to support a minimum load of 300 pounds downward pull.
- B. Frames of recessed accessories shall neatly the opening. Gaps and voids between frames and finished walls will not be allowed. Exposed and concealed fastening shall match finish of fixtures and shall be stainless steel, theft proof type.
- C. Install concealed anchor plates to wall construction for mounting all accessories. Provide grounds or rough bucks to rigidly secure accessories.

3.2 CLEANING:

- A. Remove all manufacturers temporary labels or marks of identification. Clean and polish to remove all oil, grease and foreign material. Leave accessories in a neat, orderly and clean condition acceptable to the Architect.

END OF SECTION

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. *At each lavatory or sink furnish and install an 18" x 36" mirror unless other wise noted.*
- B. *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.*
- C. *Framing: Manufacturer's standard alloy aluminum. Smooth corners. Bobrick #B-165 Series.*

2.03 FABRICATION

SECTION 10830
MIRROR UNITS

- 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.

B. Installation height to be reflective surface.

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.
- B. Stage Curtains

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.

PART 2: PRODUCTS

2.1 PRODUCTS

A. WINDOW BLINDS:

- 1. At *each classroom* window provide and install *Draper, Inc., Spring-Roller shade Heavy Duty cadmium plated hardware roller shades with Sunbloc Series B900 Fabric #SB9110 on exterior windows.*
- 2. 1" 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.

PART 3: EXECUTION

3.1 INSTALLATION:

- A. Install **MISCELLANEOUS EQUIPMENT** according to manufacturer's instructions and approved shop drawings.

3.2 CLEANING:

- A. Remove all manufacturers 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 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1- GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents.
 - 2. Furnish and install **Firestop Penetration Systems** for fire sprinkler system penetrations as described in Contract Documents.

2.1 REFERENCES

- A. Association Publications:
 - 1. Underwriters Laboratories, Inc.:
 - I. UL Directory B, 'Fire Protection Equipment Directory' (2011).
- B. Reference Standards:
 - 1. American National Standards Institute / American Society of Mechanical Engineers:
 - I. ANSI/ASME B1.20.1-1983(R2006), 'Pipe Threads, General Purpose (Inch)'.
 - II. ANSI/ASME B16.1-2010, 'Cast Iron Pipe Flanges and Flanged Fittings'.
 - III. ANSI/ASME B16.3-2011, 'Malleable Iron Threaded Fittings: Classes 150 and 300'.
 - IV. ANSI/ASME B16.4-2011, 'Gray Iron Threaded Fittings, Classes 125 and 250'.
 - V. ANSI/ASME B16.5-2009, 'Pipe Flanges and Flanged Fittings'.
 - 2. American National Standards Institute / American Water Works Association:
 - I. ANSI/AWWA C606-11, 'Grooved and Shouldered Joints'.
 - 3. American National Standards Institute / American Welding Society:
 - I. ANSI/AWA B2.1/B2.1M-2009, 'Specification for Welding Procedure and Performance Qualification'.
 - 4. ASTM International:
 - I. ASTM A53/A53M-12, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
 - II. ASTM A135/A135M-09, 'Standard Specification for Electric-Resistance-Welded Steel Pipe'.
 - III. ASTM A234/A234M-11a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
 - IV. ASTM A395/A395M-99(2009), 'Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures'.
 - V. ASTM A536-84(2009), 'Standard Specification for Ductile Iron Castings'.
 - VI. ASTM A795/A795M-08, 'Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use'.
 - 5. National Fire Protection Association / American National Standards Institute:
 - I. NFPA 13: 'Standard for the Installation of Sprinkler Systems', (2010 Edition).
 - II. NFPA 24: 'Installation of Private Fire Service Mains and their Appurtenances', (2010 Edition).

- III. NFPA 25: 'Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems', (2011 Edition).
- IV. NFPA 101: 'Life Safety Code', (2012 Edition).

3.1 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- I. Size sprinkler system piping and sprinklers by one of following methods:
 - a Hydraulic calculation design method based on water supply availability.
- II. On submittals, refer to sprinkler heads by sprinkler identification or model number published in appropriate agency listing or approval. Trade names and other abbreviated designations are not acceptable.
- III. Submittal Procedure:
 - a After award of Contract and before purchase of equipment, submit seven sets of shop drawings with specifications and hydraulic calculations to Architect and two sets to local jurisdiction having authority for fire prevention for review.
 - b After integrating Architect's and AHJ's comments into drawings, licensed certified fire protection engineer of record who designed fire protection system shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
 - c Submit stamped documents to Owner and to AHJ for fire prevention for final approval.
 - d After final approval, submit four copies of approved stamped documents to Architect.
 - e Failure of system to meet requirements of authority having jurisdiction and/or approved stamped construction documents shall be corrected at no additional cost to Owner.

B. Informational Submittals:

1. Qualification Statement:

- I. Licensed fire protection engineers or fire protection system designer:
 - a Licensed for area of Project.
 - b Certified by NICET to level three minimum.
 - c Provide Qualification documentation if requested by Architect or Owner.
- II. Installer:
 - a Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

- I. Operations and Maintenance Data:
 - a Maintenance and instructions.
 - List of system components used to indicate name and model of each item.
 - Manufacturer's maintenance instructions for each component installed in Project.

Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.

- II. Warranty Documentation:
 - a Include copies of required warranties.
- III. Record Documentation:
 - a Include copies of approved shop drawings.
 - b Provide master index showing items included.
 - c Provide name, address, and phone number of Architect, Architect's Fire Sprinkler Consultant, General Contractor, and Fire Protection subcontractor.
 - d Provide operating instructions to include:
 - General description of fire protection system.
 - Step by step procedure to follow for shutting down system or putting system into operation.
 - e Provide copy of system's above ground and below ground hydrostatic tests. Provide separate copies for Architect and Owner.
 - f Provide copy of 'Contractor's Material and Testing Certificate for Above Ground Piping' NFPA 13, Figure 24.1 (2010 edition).
- 2. Inspection:
 - I. Provide Owner with latest version of NFPA 25.
- D. Maintenance Material Submittals;**
 - 1. Extra Stock Materials:
 - I. Spare sprinkler heads in the quantity recommended by NFPA 13 selected in representative proportion to quantity used in Project and in accordance with NFPA 13 (Six (6) spare sprinkler heads minimum).
 - II. Provide spare heads in cabinet with sprinkler head wrench for each type of head used. After approval of cabinet and contents, mount cabinet in convenient location in Riser Room.

4.1 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:**
 - 1. Unless noted otherwise, system shall conform to:
 - I. NFPA 13, 'Light & Ordinary Hazard Occupancies'.
 - II. NFPA 24, 'Service Mains and Their Appurtenances, Private'.
 - III. NFPA 25, 'Inspection, Testing, and Maintenance.
 - IV. NFPA 101, 'Life Safety Code'.
 - V. Requirements of local water department and local authority having jurisdiction for fire protection.
 - VI. Underwriters Laboratories Publication, UL Directory B, 'Fire Protection Equipment Directory', current edition at time of Pre-Bid Meeting.
 - VII. Comply with backflow prevention requirements and, if required, include device in hydraulic calculations.
 - VIII. Applicable rules, regulations, laws, and ordinances.
- B. Qualifications:**

1. Licensed fire protection engineer or fire protection system designer certified by NICET to level three minimum and engaged in design of fire protection systems. Engineer / designer shall:
 - I. Licensed for area of Project.
 - II. Minimum five (5) years experience in fire protection system installations.
 - III. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - IV. Be responsible for overseeing preparation of shop drawings, hydraulic calculations where applicable, and system installation.
 - V. Make complete inspection of installation.
 - VI. Provide corrected record drawings to Owner with letter of acceptance.
 - VII. Certify that installation is in accordance with Contract Documents.
 - VIII. Upon request, submit documentation.
2. Installer:
 - I. Licensed for area of Project.
 - II. Minimum five (5) years experience in fire protection system installations.
 - III. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - IV. Upon request, submit documentation.

1.2 PRODUCTS

1.1 SYSTEM

- A. Description:
 1. Automatic wet-pipe fire sprinkler system starting at flange in Fire Riser Room and extending throughout the building as shown on the fire sprinkler drawings.
- B. Performance:
 1. Design Criteria:
 - I. Area of Application and Corresponding Design Density:
 - a. Serving Area and Mechanical, Electrical, and Janitorial Areas:
Ordinary Hazard Group 1.
Design density = 0.15 gpm per sq ft over 1,500 sq ft (140 sq m).
 - b. Storage Areas:
Ordinary Hazard Group 2.
Design density = 0.20 gpm per sq ft over 1,500 sq ft (140 sq m).
 - c. All Other Areas:
Light Hazard.
Design density = 0.10 gpm per sq ft over 1,500 sq ft (140 sq m).
 - d. Increase remote areas by 30 percent where ceiling / roof is sloped more than 2 inches (50 mm) per ft.

- e Remote areas may be reduced within parameters indicated in NFPA 13 for use of quick response sprinklers throughout.
 - II. Maximum Coverage per Sprinkler Head:
 - a Ordinary Hazard Areas: 130 sq ft (12.1 sq meters).
 - b Attic Areas: 120 sq ft (11.2 sq meters).
 - c Light Hazard Areas: 225 sq ft (20.1 sq meters).
 - III. Design Area shall be hydraulically most remote area in accordance with NFPA 13.
 - a Provide a 10 PSI safety allowance under adjusted water flow supply curve.
 - IV. Maximum velocity of water flow within piping: 20 feet (6.1 m) per sec.
- C. Components:
 - 1. General: Use only domestically manufactured cast iron pipe fittings, valves, sprinkler heads, and other components.
 - I. Pipe of foreign manufacture that meets ASTM Standards is acceptable.
 - II. Ductile iron fittings of foreign manufacture are acceptable.
 - 2. Pipe:
 - I. Schedule 40 Welded Steel:
 - a Exterior, Above Ground(if applicable): Schedule 40 hot-dip galvanized welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - b Interior, Above Ground: Schedule 40 black welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - c Connections:
 - 2 inches (50 mm) And Smaller: Screwed, flanged, or roll grooved coupling system.
 - 2-1/2 inches (64 mm) And Larger: Flanged or roll grooved coupling system.
 - 3. Fittings:
 - I. Usage:
 - a 2 inches (50 mm) And Smaller: Welded, screwed, flanged, or roll grooved coupling system. For use with schedule 40 carbon steel pipe.
 - b 2-1/2 inches (64 mm) And Larger: Welded, flanged, or roll grooved coupling system.
 - II. Types And Quality:
 - a Screwed:
 - Cast iron meeting requirements of ANSI B16.4 or ductile iron meeting requirements of ANSI B16.3 and ASTM A536, Grade 65-45-12.
 - Threaded fittings and pipe shall have threads cut to ANSI B1.20.1.
 - Do not extend pipe into fittings to reduce waterway.
 - Ream pipe after cutting to remove burrs and fins.
 - b Flanged: Steel meeting requirements of ANSI B16.5.
 - c Welded:
 - Carbon steel meeting requirements of ASTM A234/A234M.
 - Weld pipe using methods complying with AWS B2.1, level AR-3. Welding procedures and performance of welders shall comply with AWS B2.1, level AR3.
 - d Roll Grooved Pipe Coupling System:

Ductile iron meeting requirements of ASTM A395/A395M and ASTM A536, and UL listed.

Grooved products used on Project shall be from same manufacturer. Grooving tools shall be as recommended by manufacturer of grooved products.

Category Four Approved Products: See Section 01 6200 for definition of Categories:

	Gruvlok	Tyco (Grinnell)	Victaulic
Rigid Couplings	7401	772	Style 005
Flexible Couplings ¹	7000	705	Style 75
Flange Adaptors ²	7012	71	Style 744
Grooved Coupling Gaskets ³	'E' EPDM	Grade 'E' EPDM	'E' EPDM ⁴

¹ Use in locations where vibration attenuation, stress relief, thermal expansion, or seismic design is required / needed.

² Class 125 or 150.

³ Temperature rated **30 to 150 deg F** (minus one to plus 65 deg C). NSF-61 certified.

⁴ Grade 'A'.

III. Use of saddle or hole cut type mechanical tees is **NOT APPROVED**.

4. Valves:

I. Butterfly Valves:

a Design Criteria:

UL / CASA approved.

Indicating type.

b Category Four Approved Products: See Section 01 6200 for definitions of Categories:

Milwaukee:

(1) Model BB-SCS02 threaded ends with tamper switch **one inch (25 mm)** to **2 inches (50 mm)**.

(2) Model BBVSCS02 Grooved ends with tamper switch **2 inches (50 mm)** to **2-1/2 inch (64 mm)**.

Nibco:

(1) Model WD3510-8 Wafer type with valve tamper switch.

(2) Model GD4765-8N Grooved type with valve tamper switch, **2-1/2 inches (64 mm)** to **8 inches (200 mm)**.

Tyco (Grinnell):

(1) Model BFV-N wafer.

(2) Model BFV-N grooved.

Victaulic: Series 705W Grooved end type with internal supv. switches.

Kennedy:

(1) Model 01W wafer.

(2) Model G300 grooved.

II. Gate Valves:

a Design Criteria:

UL / CASA approved.

Outside Screw and Yoke Type (O.S.&Y).

- Class 150 psi.
- b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Nibco:
 - (1) T-104-0 with Threaded Ends 1/2 inch (12.7 mm) to 2 inches (50 mm).
 - (2) F-637-31 Flanged Ends.
 - Mueller: R-2360-6 Flanged Ends.
 - Victaulic: Series 771 Grooved Ends
- III. Ball Valves:
- a Design Criteria:
 - UL / CASA approved.
 - Valve tamper switch.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Milwaukee: BB-SCS02 with threaded ends.
 - Nibco: KT-505 with threaded ends.
 - Nibco: KG-505 with grooved ends.
 - Victaulic: Series 728 with grooved or threaded ends.
- IV. Swing Check Valves:
- a 1/2 to 3 inch (13 to 75 mm) horizontal check.
 - Design Criteria:
 - (1) Regrinding type.
 - (2) Renewable disk.
 - (3) Bronze Class 125 with threaded ends.
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Nibco: KT-403-W.
 - (2) Victaulic: Series 712.
 - (3) Viking: G-1 Grooved ends.
 - b 2 to 4 inch (50 to 100 mm) Horizontal check:
 - Design Criteria:
 - (1) Grooved ends.
 - (2) Ductile iron body.
 - (3) Rated 300 psi (2.07 MPa).
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Tyco (Grinnell): CV-1F Grooved ends.
 - (2) Victaulic: Series 712.
 - (3) Viking: G-1 Grooved ends.
 - c 3 to 12 inch (76 to 300 mm) Horizontal check:
 - Design Criteria:
 - (1) Bolted bonnet.
 - (2) Raised face flanges.
 - (3) Bronze mounted with ductile iron body.
 - (4) 125 lb (56.7 kg) Class A.
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - (1) Nibco: F-938-31.

- (2) Mueller: A-2120-6.
 - (3) Viking: F-1 grooved and flanged.
- V. Wafer Type Check Valves:
 - a Design Criteria:
 - 4 to 8 inch (100 to 300 mm) cast iron body.
 - 175 psi (1.21 MPa) minimum working pressure.
 - Rubber Seat.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Nibco: KW-900-W.
 - Mueller: A-2102.
 - Kennedy: Fig.706.
- VI. Grooved-End Check Valves:
 - a Design Criteria:
 - UL / CASA listed and approved to 250 psi (1.72 MPa) maximum operating pressure.
 - 2-1/2 to 12 inch (64 to 300 mm) ductile iron body.
 - Disc And Seat:
 - (1) 2-1/2 And 3 Inch (64 to 75 mm): Aluminum bronze disc with mounted elastomer seal and PPS (polyphenylene sulfide) coated seat.
 - (2) 4 Inch (100 mm) And Larger: Elastomer encapsulated ductile iron disc with welded in nickel seat.
 - (3) Viking: Model VK462.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Nibco: KG-900-W grooved ends.
 - Victaulic: Series 717.
 - Kennedy: Fig.426.
- VII. Alarm Check Valves:
 - a Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Reliable: E with gauges and drain.
 - Tyco (Grinnell): Model AV-1-300.
 - Victaulic: Series 751 with gauges and drain.
 - Viking: J-1 with gauges and drain.
- VIII. Backflow Preventer: Make and model shown on Drawings or as required by local codes.
- IX. Retard Chamber:
 - a Design Criteria:
 - Self-draining.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Reliable: E-1.
 - Victaulic: Series 752.
 - Viking: C-1.
- X. Inspector's Test Valve:
 - a Design Criteria:

- Bronze body with threaded or grooved ends.
 - Combination sight glass / orifice.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Tyco (Grinnell): Model F350.
 - Victaulic: Testmaster Alarm Test Module Style 720.
- 5. Sprinkler Heads:
 - I. Concealed Pendant:
 - a Design Criteria:
 - Adjustable cover.
 - UL / CASA listed and approved.
 - Coordinate concealed cover finish with Architect.
 - b Type One Acceptable Products:
 - Wet Pendant, Flat Profile:
 - (1) Reliable: F4FR.
 - (2) Victaulic: Model 3802.
 - (3) Viking: Model VK462.
 - (4) Tyco (Grinnell): Model RF11.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.
 - Dry Pendant:
 - (1) Flat Profile:
 - (a) Tyco (Grinnell): DS-C.
 - (b) Victaulic: V3618.
 - (2) Equal as approved by Architect before bidding. See Section 01 6200.
 - II. Horizontal Sidewall Sprinkler:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - Recess adjustable.
 - Where guards are required, use chrome plated sprinkler guards that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
 - b Type One Acceptable Products:
 - Wet System:
 - (1) Reliable: F1FR.
 - (2) Tyco (Grinnell): Model TY-FRB.
 - (3) Victaulic: Model V2710.
 - (4) Viking: VK305.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.
 - Dry System:
 - (1) Reliable: F3QR.
 - (2) Tyco (Grinnell): DS-1.
 - (3) Victaulic: Model V3610.
 - (4) Viking: VK162.
 - (5) Equal as approved by Architect before bidding. See Section 01 6200.

- III. Attic Sprinklers, Upright:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - Approved for use in roof structures, combustible and non-combustible, with ceiling below.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Tyco: BB, SD, or HIP.
- IV. Pendant Sprinklers:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - Where guards or escutcheons are required, use chrome plated sprinkler guards and escutcheons that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
 - b Type One Acceptable Products:
 - Reliable: F1FR.
 - Tyco: TY-FRB.
 - Victaulic: Model V2704.
 - Viking: VK302.
 - Equal as approved by Architect before bidding. See Section 01 6200.
- V. Upright Sprinklers:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - b Type One Acceptable Products:
 - Reliable: F1FR.
 - Tyco: TY-FRB.
 - Victaulic: Models V2704.
 - Viking: VK300.
 - Equal as approved by Architect before bidding. See Section 01 6200.
- 6. Water Flow Alarm:
 - I. Electric Flow Alarm:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Potter Electric: Horn Strobe, SASH-120, 120VAC.
 - System Sensor: Horn Strobe, P2RHK-120, 120 VAC.
- 7. Waterflow Detectors:
 - I. Electrical Water Flow Switch:
 - a Design Criteria:
 - UL / CASA listed.
 - Switch activates with flow of 10 gpm (37.85 lpm) or more.
 - Two single pole double throw switches.
 - Automatic reset.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Potter-Roemer: Model 6201 thru 6208.

System Sensor: WFD20 thru WFD80.

Viking: VSR-F.

8. Tamper Switch
 - I. Weather and Tamper Resistant Switch.
 - a Design Criteria:
 - UL / CASA listed.
 - Mount to monitor valve and not interfere with operation.
 - Shall operate in horizontal and vertical position.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Control Valves, Butterfly Valves, Post Indicator Valves:
 - (1) Potter Electric: Model PCVS.
 - (2) Notifier: Model PIBV2.
 - (3) System Sensor: Model PIBV2.
 - O.S. & Y Valves:
 - (1) Potter Electric: Model OSYSU.
 - (2) System sensor: Model OSY2.
9. Automatic Drain Device:
 - I. Design Criteria:
 - a Straight Design, 3/4 inch: (19 mm).
 - II. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a Nibco: Ball-Drip.
 - b Potter-Roemer: Figure 5982.
 - c Viking: B-1.
10. Fire Department Connection: Contractor shall check with local authority having jurisdiction to confirm the type of FDC required.
 - I. One Way Inlet with 5" Stortzguard Cap:
 - a Class One Quality Standards: See Section 01 6200:
 - Round 'AUTO SPKR' identification plate, red enamel finish aluminum plate:
 - (1) Croker: Fig 6766.
 - (2) Potter-Roemer Fig. 5966.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Rough chrome plated:
 - (1) Croker: 6405-RC.
 - (2) Potter-Roemer: Fig. 5710-C.
 - Caps and Chains:
 - (1) Croker: 6747 RC.
 - (2) Potter-Roemer: 4625.
11. Indicating Post Valve:
 - I. Design Criteria:
 - a As specified in Section 33 1119: 'Fire Suppression Water Distribution Piping'.
 - b Prefer exposed parts non-brass, for theft protection.
 - c Supervisory switch.
 - II. Category Four Approved Products: See Section 01 6200 for definitions of Categories:

- a As required by Authority Having Jurisdiction (AHJ).
- 12. Riser Manifold Assembly:
 - I. Design Criteria:
 - a Groove x Groove Manifold Body.
 - b Water Flow Alarm Switch, VSC with Vane, UL / CASA listed and approved.
 - c 300 psi (2.07 MPa) Water Pressure Gauge.
 - d Test and Drain Valve with Manifold Drain Trim and 1/2 inch (12.7 mm) diameter test Orifice.
 - e Pressure Relief Valve, 175 psi (1.21 MPa), non adjustable, pipe discharge to test Drain Valve.
 - II. Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a Tyco: Model 513.
 - b Victaulic: Style 747P.

2.1 ACCESSORIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - I. Anvil International, Portsmouth, NH www.anvilintl.com.
 - II. Cooper B-Line, Highland, IL www.b-line.com.
- B. Hangers, Rods, And Clamps:
 - 1. Design Criteria:
 - I. Galvanized, unless specified otherwise, and UL / CASA approved for service intended.
 - 2. Class One Quality Standard:
 - I. Hangers and accessories shall be Anvil numbers specified or equals by Cooper B-Line.
 - II. Pipe Ring Hangers: Equal to Anvil Fig 69.
 - III. Riser Clamps: Equal to Anvil Fig. 261.
- C. Posted System Diagram:
 - 1. Provide single, color-coded floor plan diagram showing total system. Color antifreeze pipe system elements BLUE and wet pipe system elements RED. Indicate locations of antifreeze system drains and sample test station.
 - 2. Include following information on diagram sheet:
 - I. Explanation of how to test an antifreeze system.
 - II. Step by step shut down procedure.
 - III. Step by step system drainage procedure.
 - IV. Step by step start-up procedure.
 - V. Step by step procedure for protection of system from freezing.
 - 3. Laminate diagram with plastic and mat or frame suitable for hanging near riser.
- D. Steel Deck Bracket:
 - 1. Class Two Quality Standard: See Section 01 6200.
 - I. Unistrut P1000 with clamp nut, minimum 6 inch (150 mm) length.

1.3 EXECUTION

1.1 INSTALLERS

A. Acceptable Installers. See Section 01 4301:

1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

2.1 EXAMINATION

A. Drawings:

1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit. Install system so it drains.
2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These Drawings take precedence over Fire Protection Drawings.
3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions and to enable system to drain.

3.1 INSTALLATION

A. Interface With Other Work: Provide inserts for attaching hangers in concrete floor construction at time floors are placed.

B. Connect system to flange provided under Section 33 1119. After installation of riser, fill annular space between pipe and slab with flexible mastic.

C. Install sprinkler systems in accordance with requirements of latest editions of NFPA 13 and as specified below:

1. Provide maintenance access to equipment
2. Conceal sprinkler lines installed in occupied areas. In Mezzanine areas, route pipe to side or underneath Mezzanine walkway. Do not impede egress from Attic.
3. Install to enable drainage of system.
 - I. Install main drain from riser according to NFPA 13, paragraph 8.17.4.
4. Install piping system, except for dry heads, so it will not be exposed to freezing temperatures.
5. Do not use dropped, damaged, or used sprinkler heads.
6. Install tamper switches and flow detectors where located by Architect.
7. Except for Siamese connection, install automatic ball drip device in lowest point of piping to fire department connection and drain to floor drain or to exterior of building.
8. Brace and support system to meet seismic zone requirements for building site.
9. **Inspector's Test and Drain to be placed in a location approved by the architect.**

- D.** Flush system at full design flow rate for minimum five minutes. Route water to outside of building. Protect landscaping and other exterior elements from damage during flow tests.

4.1 FIELD QUALITY CONTROL

A. Field Tests:

1. Pressure Test:
 - I. Hydrostatically test system to **200 psi (1.38 MPa)** minimum for 2 hours as required by 'Contractor's Material And Testing certificate for Above Ground Piping' NFPA-13.
 - II. If system or part of system is to have a glycol solution, hydrostatic test is to be performed using approved glycol solution. Do not hydrostatically test any section of system that is to be filled with a glycol solution with plain water.
2. Water Flow Test:
 - I. Test to determine static and residual pressures and corresponding flow rate at point of connection to utility water main.
 - II. Adjust water flow test data for seasonal fluctuations and future growth as recommended by Water Utility and AHJ.
 - III. At point of connection to utility water main, combine inside and outside hose stream allowances.
3. Check piping in relation to insulation envelope to be certain piping and auxiliary drains are properly enclosed inside building insulation envelope. Report unsatisfactory conditions to Architect.
4. Tests shall be witnessed by Architect and representative of local jurisdiction over fire prevention.

5.1 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:

1. Instruction Sessions:
 - I. Instruct Owner's personnel in operation and maintenance of system utilizing 'Operation And Maintenance Manual' when so doing. Minimum instruction period shall be four (4) hours.
 - a Include antifreeze system requirement to be tested at least once a year.
 - II. Instruction sessions shall occur after Substantial Completion inspection when system is properly working and before final payment is made.
 - III. Provide Owner with latest version of NFPA 25.

B. Training:

1. Installer required to provide FM Training from latest version of NFPA 25 with checklist and brief explanation of following inspections:
 - I. Weekly Inspection.
 - II. Monthly Inspection.
 - III. Quarterly Inspection.
 - IV. Semi-Annual Inspection.
 - V. Annual Inspection.

END OF SECTION

SECTION 22 00 00

SUMMARY OF PLUMBING WORK

PART 1 - GENERAL

1.1 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. Plumbing 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 systems and equipment as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect all water, sewer, and/or power to fixtures.
 - 2. Provide all materials and labor associated with a complete operational installation of new systems including, but not limited to:
 - Fixtures for facility
 - Piping for Sanitary Sewer and Vent Systems
 - Piping for Domestic water and Hot Water Systems.

1.2 COORDINATION

- A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, even in areas where only plumbing 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 plumbing equipment.

1.3 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.

1.4 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.

1.5 SUBMITTALS

- 1. All equipment and fixtures shall be provided with a submittal.
- 2. To expedite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Common requirements and procedures for plumbing systems.
2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
3. Furnish and install sealants relating to installation of systems installed under this Division.
4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:

1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's catalog data for each manufactured item.

- 1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
- 2) Include name, address, and phone number of each supplier.

B. Informational Submittals:

1. Qualification Statement:

a. Plumbing Subcontractor:

- 1) Provide Qualification documentation if requested by Architect or Owner.

b. Installer:

- 1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):

- 1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:

a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.

b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:

- (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.

- (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
- c) Provide operating instructions to include:
 - (1) General description of fire protection system.
 - (2) Step by step procedure to follow for shutting down system or putting system into operation.
- b. Warranty Documentation:
 - 1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 - 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
- B. Qualifications.
 - 1. Plumbing Subcontractor:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in plumbing installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Accept valves on site in shipping containers with labeling in place.
 - 2. Provide temporary protective coating on cast iron and steel valves.
 - 3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Storage And Handling Requirements:
 - 1. In addition to requirements specified within, stored material shall be readily accessible for inspection by Architect/engineer until installed.
 - 2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

- A. Manufacturer Warranty:

1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.
- B. Special Warranty:
 1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 2. If plumbing sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local plumbing sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
- B. Pipe And Pipe Fittings:
 1. Weld-O-Let and Screw-O-Let fittings are acceptable.
 2. Use domestic made pipe and pipe fittings on Project, except non-domestic made cast iron pipe and fittings by MATCO-NORCA are acceptable.
- C. Sleeves:
 1. General:
 - a. Two sizes larger than bare pipe or insulation on insulated pipe.
 2. In Concrete And Masonry:
 - a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
 3. In Framing And Suspended Floor Slabs:
 - a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal.
- D. Valves:
 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers:

3.2 Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.3 EXAMINATION

- A. Drawings:
 1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.
 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- B. Verification Of Conditions:

1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
 2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
 3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- 3.4 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- 3.5 PREPARATION
- A. Demolition Requirements:
 - B. Changes Due To Equipment Selection:
 1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
 4. Be responsible for proper location of rough-in and connections provided under other Divisions.
- 3.6 INSTALLATION
- A. Interface With Other Work:
 1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
 2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.
 3. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
 - B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.
 - C. Locating Equipment:
 1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
 2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
 3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.

4. Determine exact route and location of each pipe before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.
- D. Penetration Firestops:
 1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.
- E. Sealants:
 1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.
- F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe **3/4 inch (19 mm)** in diameter and smaller.
 - d. Install piping systems so they may be easily drained
 - e. Install piping to insure noiseless circulation.
 - f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 3. Do not install piping in shear walls.
 4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
 5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
 6. Make changes in direction with proper fittings.
 7. Expansion of Thermoplastic Pipe:

- a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.

G. Sleeves:

1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade (unless noted on plans).
2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe (if used) penetrations through studs and floor slabs.
3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:

1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.7 REPAIR / RESTORATION

- A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 2. Surface finishes shall exactly match existing finishes of same materials.

3.8 FIELD QUALITY CONTROL

A. Field Tests:

1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:

1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.9 CLEANING

A. Remove dirt, grease, and other foreign matter from each length of piping before installation:

1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.10 CLOSEOUT ACTIVITIES

A. Instruction of Owner:

1. Instruct building maintenance personnel in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.

2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.11 PROTECTION

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for plumbing systems.
- B. Products Installed But Not Furnished Under This Section:
 - 1. Paint identification for gas piping used in HVAC equipment.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Anvil International,
 - b. Cooper B-Line,
 - c. Unistrut, Wayne,
- B. Materials:
 - 1. Hangers, Rods, And Inserts
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - 1) Support insulated pipes **2 inches** in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
 - 2) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger: Anvil Fig. 69.
 - (2) Insulation Protection Shield: Anvil Fig. 167.
 - (3) Equals by Cooper B-Line.
 - 3) Support insulated pipes **2-1/2 inches** in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger: Anvil Fig. 260.
 - (2) Roller Assembly: Anvil Fig. 171.
 - (3) Insulation Protection Shield: Anvil Fig. 167.
 - (4) Equals by Cooper B-Line.
 - 4) Support uninsulated copper pipe **2 inches** in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
 - (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.

- (3) Equals by Cooper B-Line.
- 5) Support uninsulated copper pipe **2-1/2 inches** in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
 - (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
 - (3) Equals by Cooper B-Line.

c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

- 1) Size trapeze angles so bending stress is less than **10,000 psi**
- e. Riser Clamps For Vertical Piping:
 - 1) Type Two Acceptable Products:
 - a) Anvil Fig. 261.
 - b) Equals by Cooper B-Line.
- f. Concrete Inserts:
 - 1) Individual Inserts:
 - a) Suitable for special nuts size **3/8 inch** through **7/8 inch** with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
 - b) Type Two Acceptable Products:
 - (1) Anvil Fig. 282.
 - (2) Equals by Cooper B-Line.
 - 2) Continuous Inserts:

- a) Class Two Quality Standard: Equal to Unistrut P-3200 series.
- g. Steel Deck Bracket:
 - 1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work: If project contains concrete structural system.
 - 1. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
- B. Piping:
 - 1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - 2) Support thermoplastic pipe at 48 inches on center maximum.
 - 3) Support PEX pipe at 32 inches minimum on center.
 - 4) Provide support at each elbow. Install additional support as required.
 - c. Supports for Vertical Piping:
 - 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
 - d. If Structural concrete systems are used: Install supports from inserts cast into concrete floor system, including concrete joists and floor slabs. Where inserts cannot be used, provide expansion shields and support hangers from angles held in place by expansion bolts, never directly from expansion bolt itself. Provide calculations necessary to determine number of expansion bolts required to equal capacity of cast-in-place insert.
 - e. Attach Unistrut to structural steel roof supporting structure. Spacing and support as described above.
 - f. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
 - 2. Gas piping Identification:
 - a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:

1. Labels:

a. Equipment Identification:

- 1) Black formica, with white reveal when engraved.
- 2) Lettering to be 3/16 inch high minimum.

2. Paint:

a. One Coat Primer:

- 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
- 2) 6-205 Metal Primer under dark color paint.
- 3) 6-6 Metal Primer under light color paint.

b. Finish Coats: Two coats 53 Line Acrylic Enamel.

c. Type Two Acceptable Products.

- 1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use. Maintain specified colors, shades, and contrasts.

- a) Benjamin Moore,
- b) ICI Dulux,
- c) Sherwin Williams,

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:

1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
2. Water Heaters.
3. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Room(s) served.
 - c. Panel and breaker from which unit is powered.

B. Painting:

1. Only painted legends, directional arrows, and color bands are acceptable.
2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.

- c. On each riser and junction.
- d. Every **25 feet** on long continuous lines.
- e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

A. Schedules:

1. Pipe Identification Schedule:

- a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation
Domestic Cold Water	CW
Domestic Hot Water	HW

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART1- GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
 - 2. Furnish and install insulation on roof drain piping as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 1116: 'Domestic Water Piping'.
 - 2. Section 22 1400: 'Facility Storm Drainage'.(if provided on plans)

1.2 SUBMITTALS

- A. Informational Submittals:
 - 1. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 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.

1.4 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.

Service Water Temperature	Pipe Sizes		
	Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified 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.

1.6 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 COMPONENTS

A. Manufacturers:

1. Manufacturer Contact List:

- a. Armacell, Mebane, NC www.armacell.com.
- b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
- c. IMCOA, Youngsville, NC www.nomacokflex.com.
- d. Johns-Manville, Denver, CO www.jm.com.
- e. Knauf, Shelbyville, IN www.knauffiberglass.com.
- f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
- g. Nomaco Inc, Yopungsville, NC www.nomacokflex.com.
- h. Owens-Corning, Toledo, OH www.owenscorning.com.
- i. Speedline Corp, Solon, OH www.speedlinepvc.com.
- j. CertainTeed Manson.
- k. Knauf FiberGlass GmbH.
- l. Owens-Corning Fiberglas Corp.
- m. Schuller International, Inc.
- n. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- o. Armstrong World Industries, Inc.
- p. Rubatex Corp.

B. Materials:

1. Above Grade Metal Piping:

a. Insulation For Piping:

- 1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
- 2) Insulation Thickness:
- 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
- 4) Type One Acceptable Manufacturers:
 - a) Childers Products.
 - b) Knauf.
 - c) Manson.
 - d) Owens-Corning.
 - e) Johns-Manville.
 - f) Equal as approved by Architect before bidding. See Section 01 6200.

b. Fitting, Valve, And Accessory Covers:

- 1) PVC.
- 2) Performance Standard: Zeston by Johns-Manville.
- 3) Type One Acceptable Manufacturers:

- a) Knauf.
 - b) Speedline.
 - c) Johns-Manville.
 - d) Equal as approved by Architect before bidding. See Section 01 6200.
- 2. Below Grade Metal Piping:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 3. Pex Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit
 - b) by Armacell.
 - c) ImcoLock by Imcoa.
 - d) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
 - c)
- 4. PP-R Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 5. PVC or ABS Piping, Above And Below Grade - Facility Storm Drain:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.

- b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
- b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Above Grade Piping:
 - 1. Apply insulation to clean, dry piping with joints tightly butted.
 - 2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
 - 3. Piping up to **1-1/4 inch** Diameter:
 - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
 - b. Adhere **3 inch** wide self-sealing butt joint strips over end joints.
 - 4. Piping **1-1/2 inches** Diameter And Larger:
 - a. Use broken-joint construction in application of two-layer covering.
 - b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
 - 1) Apply by hand in several layers to make up total specified thickness.
 - 2) Final layer shall have smooth uniform finish before application of covering.
 - 5. Fittings, Valves, And Accessories:
 - a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
 - b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
 - c. Piping Up To **1-1/4 Inch** Diameter:
 - 1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
 - 2) Alternate Method:
 - a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two **1/8 inch** wet coats of vapor barrier mastic reinforced with glass fabric extending **2 inches** onto adjacent insulation.
 - d. Piping **1-1/2 inches** To **2 Inches** :
 - 1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
 - 2) Apply final coat of fitting mastic over insulating cement.
 - e. Piping **2-1/2 inch** And Larger:
 - 1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
 - 2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
 - 6. Pipe Hangers:
 - a. Do not allow pipes to come in contact with hangers.

b. Pipe Shield:

- 1) Provide schedule 40 PVC by 6 inch long at each clevis and/or unistrut type hanger.
- 2) Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
- 3) Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.

c. At Pipe Hangers:

- 1) Provide rigid calcium silicate insulation (100 psi compressive strength) at least 2 inches beyond shield.
7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

B. Below Grade Piping:

1. Slip underground pipe insulation onto pipe and seal butt joints.
2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

3.2 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.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.4 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. Firestopping and fire-resistive joint sealers are specified in Section "Firestopping."

3.5 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.

3.6 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.

B. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded 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.

C. Apply insulation to valves and specialties as follows:

1. Apply premolded 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.

3.7 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 premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 2. When premolded 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 premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 2. When premolded 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 stainer 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.

3.8 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 stainer 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.

3.9 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.

3.10 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.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. 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.
- B. 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.
- 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: 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: Aluminum Jacket on building exterior application only.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.
- E. Service: For obtaining fire/smoke rating in return air plenum (calbes, 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.

3.12 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: 1/2"
 - 4. Field-Applied Jacket: Aluminum

- 5. Vapor Retarder Required: Yes.
- 6. Finish: None.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- B. Includes But Not Limited To:
 - 1. Perform excavating and backfilling required by work of this Section.
 - 2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines **5 feet** from building perimeter as described in Contract Documents.

1.2 PERFORMANCE REQUIREMENTS

- B. 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..

1.3 SUBMITTALS

- B. Action Submittals:
 - 1. Product Data: For pipe, tube, fittings, and couplings.
 - 2. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - b. Written report of sterilization test.
- D. Shop Drawings:
 - b. Piping Layout:
 - 1) Provide as-built drawings at end of project.

1.4 QUALITY ASSURANCE

- B. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- D. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components.
- E. 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 SYSTEMS

A. Manufacturers:

1. Manufacturer Contact List:

- b. Aquatherm, Inc.,
- c. Cash Acme,
- d. Cla-Val Company,
- e. Conbraco Industries Inc,
- f. Hammond Valve,
- g. Handy & Harmon Products Div,
- h. Honeywell Inc,
- i. Leonard Valve Co,
- j. Milwaukee Valve Co,
- k. Nibco Inc,
- l. Rehau,
- m. Sloan Valve Co,
- n. Spence Engineering Co,
- o. Symmons Industries, Braintree,
- p. Uponor Inc,
- q. Viega ProPress, Wic
- r. Watts Regulator Co,
- s. Wilkins (Zurn Wilkins),
- t. Zurn PEX, Inc.

B. Materials:

1. Design Criteria:

- b. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
- c. No CPVC allowed.

2. Pipe:

b. Copper:

3) Above-Grade:

- a) Meet requirements of ASTM B88, Type K & L.
- b) Hard Copper Tube: ASTM B 88, Types K and L, water tube, drawn tempered.
- c) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

- d) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 - e) 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.
 - f) Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
 - g) 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.
- 4) Below-Grade:
 - a) Meet requirements of ASTM B88, Type K. **3/4 inch** minimum under slabs.
 - b) **2 inches** And Smaller: Annealed soft drawn.
 - c) **2-1/2 inches** And Larger: Hard Drawn.
- 5) Fittings:
 - a) For Copper Pipe: Wrought copper.
- 3. Connections For Copper Pipe:
 - b. Above-Grade:
 - 3) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
 - 4) Viega ProPress System
 - c. Below Grade:
 - 3) Brazed using following type rods:
 - a) Copper to Copper Connections:
 - 2) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - 3) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 4) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
 - 5) Do not use rods containing Cadmium.
 - 6) Brazing Flux:
 - a) Approved Products:
 - 1) Stay-Silv white brazing flux by Harris Product Group.
 - 2) High quality silver solder flux by Handy & Harmon.
 - 7) Joints under slabs acceptable only if allowed by local codes.
- 4. Ball Valves:
 - b. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
 - c. Valves shall be two-piece, full port for **150 psi** SWP.
 - 3) Operate with flow in either direction, suitable for throttling and tight shut-off.
 - 4) Body: Bronze, **150 psig** wsp at **350 deg F** and **400 psig** wog.
 - 5) Seat: Bubble tight at **100 psig** under water.
 - d. Class One Quality Standard: Nibco T585 or S585.
 - 3) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.

5. Combination Pressure Reducing Valve / Strainer:
 - b. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
 - c. Built-in thermal expansion bypass check valve.
 - d. Class One Quality Standard: Watts LFU5B:
 - 3) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Below Grade:
 1. Install piping under slabs without joints where possible.
 2. Insulate water piping buried within building perimeter.
 3. Bury water piping **6 inches** minimum below bottom of slab and encase in **2 inches** minimum of sand.
- B. Locate cold water lines a minimum of **6 inches** from hot water line.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Before pipes are covered, test systems in presence of Architect/Engineer at **125 psig** hydrostatic pressure for four (4) hours and show no leaks.
 2. Disconnect equipment not suitable for **125 psig** pressure from piping system during test period.

3.3 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.

3.4 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:
 - b. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - c. Fill and isolate system according to either of the following:
 - 3) 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.

- 4) 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.
 - d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - e. 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.
- D. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 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.

1.2 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

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.
- B. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Flow Design, Inc.
 - 3. ITT Industries; Bell & Gossett Div.
 - 4. Taco, Inc.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. 2" and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 - 7. 2" and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 - 8. 2.5" and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- C. 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.
- D. Manufacturers:

1. Conbraco Industries, Inc.
2. Crane Co., Crane Valve Group; Crane Valves.
3. Grinnell Corporation.
4. NIBCO INC.
5. 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. Ice-maker 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.
 1. Inlet: 3/4 " or NPS 1" 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 ROOF HYDRANTS

- A. Design Criteria:
 - 1. Provide dual check backflow preventer.
 - 2. Non-freeze.
 - 3. Drain port - connect to drain

2.6 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
- B. Manufacturers:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Precision Plumbing Products, Inc.
 - 4. Smith, Jay R. Mfg. Co.
 - 5. 125-psig (860-kPa) minimum working pressure.
 - 6. Bronze body with atmospheric-vented drain chamber.
 - 7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 - 8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 - 9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 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.
- B. Manufacturers:
 - 1. Josam Co.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Tyler Pipe; Wade Div.
 - 4. Zurn Industries, Inc.; Specification Drainage Operation.
- C. 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.
- D. 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.

- E. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- F. 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.
- G. 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.
- H. 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.
- I. 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.
- J. 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.

2.8 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.
 - 3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.9 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.
 - 1. Not required to meet NSF International Standards for Lead Free.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Jay R. Smith: 5907.
 - 2) Prier: P-RH2.

- 3) Woodford: RHY2-MS.
3. Water Hammer Arrestors:
 1. Design Criteria:
 - 1) Meet NSF International Standards for Lead Free.
 - 2) Nesting type, air pre-charged bellows with casing.
 - 3) Bellows constructed of stabilized 18-8 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- C. 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.
- D. 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.
- E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect plumbing specialties and devices that require power.

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 "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.

END OF SECTION

SECTION 22 13 13

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines **5 feet** out from building where applicable.
2. Perform excavation and backfill required by work of this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Cover Observation.

1. Contact Architect/Engineer prior to covering any section of pipe.
2. All piping all be under pressure during observation

1.3 REFERENCES

A. Reference Standards:

1. International Code Council:
 - a. ICC IPC-2012, 'International Plumbing Code'.

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 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.
- ###### C. Plenum Vent Lines: In areas of building with a return air plenum.
1. Approved Types:
 - a. Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A74.
 - b. Vent lines **2-1/2 inches** or smaller may be Schedule 40 galvanized steel.
 - c. Joint Material:

- 1) Single-Hub: Rubber gaskets meeting requirements of ASTM C564.
- 2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
- d. Fittings:
- e. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A74.
- 1) Joint Material: Rubber gaskets meeting requirements of ASTM C564.
- 2) Galvanized Pipe: Screwed Durham tarred drainage type.

2.2 EXECUTION

2.3 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. 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.
- C. 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 $\frac{1}{8}$ - 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.
- D. 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.
- E. 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.
- F. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:
- G. 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.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.4 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 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.
 - 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

2.5 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Conduct tests for leaks and defective work. Notify Architect before testing.
 - 2. Thermoplastic Pipe System:
 - a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or **10 feet** minimum, and show no leaks for two hours. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.
- B. 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.
- C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. 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.

2.6 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 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
 - 1. Cleanouts.
 - 2. Floor drains.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 2. Storm Drainage Piping: 10-foot head of water.

1.3 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. Cleanouts, floor drains, and roof drains.
 - 2. Roof flashing assemblies.
 - 3. Grease interceptors(if applicable)
 - 4. Sleeve penetration systems.

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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.

2.4 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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.
- B. 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.
- C. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- D. 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.
- E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

- G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- I. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- J. 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.
- K. 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.
- L. 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.
- M. 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.
- N. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- O. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- P. 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. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect plumbing specialties and devices that require power according to Division Sections.
- E. 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.
- 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 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install electric water heater as specified in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 61-2012, 'Drinking Water System Components - Health Effects'.
 - b. NSF/ANSI 372-2011, 'Drinking Water System Components - Lead Content'.

B. SUBMITTALS

- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data:
 - 1) Maintenance and operational instructions.
 - b. Warranty Documentation:
 - 1) Final, executed copy of Warranty.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Manufacturer's literature or cut sheet.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.4 WARRANTY

- A. Special Warranty:
 - 1. Three-year non-prorated warranty on water heaters of 20 gallon capacity and larger.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. A O Smith Water Products Co,
 - b. Bradford-White Corp, Ambler,.
 - c. Rheem / Ruud Water Heater Div
 - d. Ruud Manufacturing Co.,

e. State Industries Inc,

B. Materials:

1. Design Criteria:

- a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
- b. All water heaters require 'Tempered Water Temperature Control' (mixing valves) as specified in Section 22 1116.

2. 30 Gallon to 50 Gallon Regular Height:

- a. Glass lined storage tank pressure tested and rated for 125 psi (862 kPa) working pressure.
- b. Water heaters shall each have ASME rated temperature-pressure relief valve rated at MBH input of heater minimum set to relieve at 120 psi (827 kPa).
- c. 9 Kw.
- d. 3 inches (75 mm) minimum glass fiber or polyurethane foam insulation.
- e. Complete with two stage thermostat, magnesium anode, electric sheath rod type heating element, and high limit control.
- f. Heater shall be pre-wired and entire unit bear UL label.
- g. Manufactures
 - 1) American:
 - 2) A O Smith:
 - 3) Bradford White:
 - 4) Rheem
 - 5) State Industries: SB6-40.

2.2 ACCESSORIES

A. Anchoring Components:

1. One inch (25 mm) by 18 ga (1.2 mm) galvanized steel straps.
2. No. 10 by 2-1/2 inch (64 mm) screws.

B. Thermal Expansion Absorbers:

1. Bladder type for use with potable water systems.

C. Type One Acceptable Products.

- a. Therm-X-Trol ST-12-C by Amtrol Inc, West Warwick, RI www.amtrol.com.
- b. Equal as approved by Architect before bidding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.

3.2 ADJUSTING

- A. Set discharge water temperature at 140 deg F (60 deg C). Final hot water temperature shall be 110 deg F (43 deg C) after mixing valve. If no mixing valve set discharge temperature at 110 deg F (43 deg C).

END OF SECTION

SECTION 22 42 00

COMMERCIAL 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.

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 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

2.4 TOILET SEATS

- A. Toilet Seat: Solid plastic.

1. Manufacturers:
 - a. Bemis.
 - b. Beneke.
 - c. Centoco.
 - d. Church.

2.5 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.

2.6 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: Not required
- C. Lavatory Support: Not required

- 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.

2.7 WATER CLOSETS

- A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - 2. American Standard, Inc.
 - 3. Kohler Co.
 - 4. TOTO USA, Inc.
- B. Water Closets: Ligature Resistant Institutional Combination Lavatory/Toilet
 - 1. Products:
 - a. ACORN
 - b. All others shall be submitted for pre-approval prior to bid date.

2.8 LAVATORIES, SINKS

- A. Lavatories,: Accessible, counter top, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Toto
 - d. CRANE

2.9 SINKS

- A. Sinks: Commercial, counter-mounting, stainless-steel fixture.
 - 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.

2.10 SERVICE SINKS

- A. Service/Mop 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 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and 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.

1.5 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 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 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 for sealant and installation requirements.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 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 23 00 00

HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions

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:

- DX Split System A/C Units
- Exhaust fans
- Sheet metal, Ductwork
- Diffusers and Grilles
- Duct accessories, including grilles, and louvers
- Air Test and Balance

1.3 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.

1.4 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.

1.5 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.

1.6 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 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other 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:
- G. PVC: Polyvinyl chloride plastic.
- H. 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 architectural section.

- 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. 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 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.

2.7 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.

2.8 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-psig, 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 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.
 - 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.
- 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 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.

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 23 05 39

HANGER & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- .1 Section includes:

- .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 05 12 23 - Structural Steel for Buildings.
- .5 Section 05 50 00 - Metal Fabrications.

1.3 REFERENCES

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Materials Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP-69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements

- .1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed for approval by Owner's Representative.
- .3 Submit shop drawings and product data for following items:
- .1 Bases, hangers and supports.
- .2 Connections to equipment and structure.
- .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
- .1 Owner's Representative will make available 1 copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.6 QUALITY ASSURANCE

- .1 Health and Safety:
- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
- .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
- .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
- .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.

- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.
- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: MSS SP-89.
 - .2 Steel brackets: MSS SP-89.
 - .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation saddles for hot pipework.
 - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

- .1 To Section 05 50 00 - Metal Fabrication.

2.10 HOUSE-KEEPING PADS

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-place Concrete by Division 3.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

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 Divisions. 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.

C. Valve-Tag Color:

- a. Cold Water: Green.
- b. Hot Water: Yellow.
- c. Fire Protection: Red.

2. 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

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow 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.

1.2 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.

1.3 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.

1.4 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.

1.5 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.

1.6 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.

1.7 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 specifications.
- 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 equipment for installation and for properly operating safety interlocks and controls.
- M. 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. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 5. Sensors are located to sense only the intended conditions.
 6. Sequence of operation for control modes is according to the Contract Documents.
 7. 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.
 8. Interlocked systems are operating.
 9. Changeover from heating to cooling mode occurs according to design values.
- N. 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. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, fire dampers are open.
 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 6. Windows and doors can be closed so 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 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.

3.7 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

3.12 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. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. 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. Roof Top Unit Test Reports: For 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.
 - l. Discharge air temperature
- 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.
 - h. Discharge air temperature
- 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. 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.

3.13 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 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 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.

1.4 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.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.6 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.
 - d. Schuller International, Inc.

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 Field Applied Jacket

- A. Foil and paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

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. 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.

2.5 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 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-, and outside-air ductwork.
 - 2. Indoor exposed supply-, return-, 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: 3 inches (R-8 or greater)
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and paper.
 - 5. Vapor Retarder Required: Yes.
- B. Service: Round and rectangular, return-air ducts, outside air duct, concealed or exposed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and Paper
 - 5. Vapor Retarder Required: Yes.
- C. Service: Round and rectangular, supply and return-air ducts, exposed and in mechanical rooms.
 - 1. Material: 2" liner insulation
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No
- D. Service: Round and rectangular, exhaust air ducts, concealed & exposed and in mechanical rooms.
 - 1. Material: 1" Interior liner
 - 2. Thickness: 1 inches
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No

END OF SECTION

SECTION 23 08 00

COMMISSIONING HVAC SYSTEM

PART I - GENERAL

1.1 DESCRIPTION

- A. Commissioning shall be done in accordance with ASHRAE 90.1, 6.7.2.4. System Commissioning and Guideline 0-2013
- B. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the owners Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 23, is required in cooperation with the owner and the Commissioning Agent.

1.2 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the project engineer. This list will be reviewed and approved by the Architect/Engineer prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 HEATING, VENTILATING, BUILDING AUTOMATION SYSTEMS (HVAC CONTROLS), AND TAB WORK

- A. Provide at least 2 weeks' notice prior to manufacturer's check-test-start.
- B. Provide duct leak test plan at least 2 weeks prior to each test
- C. Provide 2 weeks' notice prior to functional testing, duct leak testing, and flushing and cleaning.
- D. Provide 2 weeks' notice prior to each training session.
- E. Fax or e-mail all notifications directly to the Commissioning Authority.
- F. All required forms must be collected and provided for the Commissioning Binder by the contractor.
- G. Provide brief agenda for each training session with the 2-week notification
- H. Check, test, start and DEBUG all equipment before commissioning. If system "fails" commissioning or debugging becomes necessary during commissioning, commissioning shall be rescheduled.
- I. Provide adequate maintenance clearance around all equipment or the equipment will "fail" commissioning.
- J. Install all equipment per manufacturer's recommendations or the equipment will "fail" commissioning. If a conflict arises, mfg. versus specification requirements, ask before you install.
- K. Do not schedule training until commissioning has been successful, all punch-list items relative to that system have been corrected, and all tests are completed and test results resolved.
- L. Review and comply with the "O&M Check-List" before submitting draft O&M Manuals for review.
- M. The commissioning tasks applicable to the mechanical, BAS and TAB work of Division 23 are as follows (all references apply to equipment to be commissioned only):
 - 1. Construction and Acceptance Phase Requirements
 - a. Submittal data, commissioning documentation, O&M data and training.

- b. Attend all commissioning meetings.
 - c. Provide shop drawings of equipment to be commissioned along with completed & signed Pre-Functional checklists.
 - d. Document start-up and functional testing procedures including.
 - 1) Manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, Owner-contracted tests, fan and pump curves, all factory testing reports, and all warranty information.
 - 2) The Owner will require additional documentation necessary for LEED submittals if required by USGBC.
 - e. Table of Contents with listing of all equipment that will be included in the O&M manuals for review and approval.
 - f. Specific functional performance test procedures.
 - g. Alarm limits to be used during the tests.
 - h. Start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists for all equipment to be commissioned. Submit to AE for review and approval prior to startup. Refer to *Section 01 91 13* for further details on start-up plan.
 - i. Prior to startup and initial checkout process, execute the mechanical prefunctional checklists for all equipment to be commissioned.
 - j. Perform and clearly document all system operational checkout procedures and completed startup, promptly providing a copy to the Owner as components are completed and systems are debugged and completed.
 - k. Correct all punch list items before functional testing.
 - l. Air and water TAB shall be completed with discrepancies and problems remedied before requesting Owner witnessing functional testing.
 - m. Functional Performance Tests / Procedures may be used to perform adjustments prior to witnessing by the AE and Owner.
 - n. Complete functional performance testing for specified equipment in Section 01 91 13. Assist the Owner in interpreting the monitoring data.
 - o. Correct deficiencies as interpreted by the *Cx Agent* and Engineer and retest the equipment prior to Functional Performance Witnessing by the CxA. Coordinate scheduling of Functional Performance Witnessing with the *Cx Agent* and Owner.
 - p. Provide all Documentation, Plans, Reports, Notes, Output from Electronic Commissioning Tools / other analysis tools to the Owner promptly upon successful Functional Test witnessing.
 - q. Update O&M manuals according to the Contract Documents.
 - r. Provide training of the Owner's operating staff.
 - s. Document specific requirements to maintain the validity of the warranty.
2. Warranty Period
- a. Execute seasonal or deferred functional performance testing, witnessed by the Owner.
 - b. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.4 HEATING AND VENTILATING WORK

- A. Provide startup for all HVAC equipment, except for the BAS system.
- B. Assist and cooperate with the TAB contractor and Owner by:

1. Include all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning.
 2. Include sheaves and belts that may be required by TAB.
 3. Provide test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
 4. Provide temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
- C. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the Owner. Update the schedule.
- D. Notify the or Owner depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the *Cx Agent* and Engineer, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed, and that the Owner has the scheduling information needed to efficiently execute the commissioning process.

1.5 BAS(HVAC CONTROLS) WORK

- A. Sequences of Operation Submittals. The BAS submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
1. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
 2. All interactions and interlocks with other systems.
 3. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 4. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
 5. Start-up sequences.
 6. Warm-up mode sequences.
 7. Normal operating mode sequences.
 8. Unoccupied mode sequences.
 9. Shutdown sequences.
 - 10.Capacity control sequences and equipment staging.
 - 11.Temperature and pressure control: setbacks, setups, resets, etc.
 - 12.Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - 13.Effects of power or equipment failure with all standby component functions.
 - 14.Sequences for all alarms and emergency shut downs.
 - 15.Seasonal operational differences and recommendations.
 - 16.Initial and operational values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc., that will be useful during testing and operating the equipment.
 - 17.Schedules, if known. (When ready to program, request Schedules from the AE if not already available).
 - 18.To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

19. Prior to Functional Performance Witnessing by the Owner, correct deficiencies as may be interpreted by the *Cx Agent* and Engineer and retest the equipment. Coordinate and confirm scheduling of Functional Performance Witnessing with the *Cx Agent* and Owner providing a pdf of successful trending as indication systems are ready for this procedural test phase.
 20. Promptly provide all Documentation, Plans, Reports, Notes, Output from Electronic Commissioning Tools / other analysis tools to the Owner.
- B. Control Drawings Submittal
1. The control drawings shall have a key to all abbreviations.
 2. The control drawings shall contain graphic schematic depictions of the systems and each component.
 3. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 4. Provide a full points list with at least the following included for each point:
 - a. Controlled system
 - b. Point abbreviation
 - c. Point description
 - d. Display unit
 - e. Control point or setpoint
 - f. Monitoring point
 - g. Intermediate point
 - h. Calculated point
 - i. Point Description: DB temp, airflow, etc.
 - 1) Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)
 - 2) Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
 - 3) Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
 - 4) Calculated Point: "Virtual" point generated from calculations of other point values.
 - j. The Contractor shall keep the Owner informed of all changes to this list during programming and setup.
- C. The Contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, including:
1. System name.
 2. List of devices.
 3. Procedures for testing each controller after installation.
 4. A blank copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 5. A description of the instrumentation, if any, required for testing.
 6. Identify what tests on what systems must be completed for TAB work. Coordinate with the Owner and TAB contractor for this determination.
- D. Assist the TAB contractor in the following manner:

1. Review the TAB plan to determine the capabilities of the building automation system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 2. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system debugged, completed then approved by the Owner prior to TAB.
 3. Provide a qualified technician to operate the controls during TAB, or provide sufficient training for TAB to operate the system without assistance.
 4. Provide an all points report (digital) validating commands and responses with calibrated data matching and validating the required data / Report from the TAB.
- E. Provide a signed and dated certification to the *Cx Agent* and Engineer upon completion of the checkout for all controlled devices, equipment and systems prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.
 - F. Assist and cooperate with the Owner in the following manner:
 - G. In addition to the control points necessary to execute all control sequences, provide monitoring, control and virtual points as required in the Contract Documents.
 - H. Prior to Functional Performance Witnessing by the Owner, correct deficiencies as may be interpreted by the *Cx Agent* and Engineer to retest the equipment. Coordinate and confirm scheduling of Functional Performance Witnessing with the *Cx Agent* and Owner.
 - I. Promptly provide all Documentation, Reports, Notes, Output from Electronic Commissioning Tools / other analysis tools to the Owner.
 - J. List and clearly identify on the as-built duct and piping drawings, the locations of all static and differential pressure sensors (air, water and building pressure).
 - K. An updated as-built version of the control drawings and sequences of operation shall be included in the final BAS O&M manual submittal.

1.6 TAB WORK

- A. Prior to starting TAB, submit to the *Engineer* the qualifications of the site technician for the project, including the name and contact information of the contractors and facility managers of recent projects the technician on which was lead. The Owner shall approve the site technician's qualifications for this project.
- B. A running log of events and issues shall be kept by the TAB field technicians. Discrepancies, deficiencies or uncompleted work by others, contract interpretation requests and lists of completed tests shall be provided to the Owner and *Cx Agent* and Engineer prior to Witness Phase of Functional Testing.
- C. Communicate in writing or during recorded meetings with the *Cx Agent* and Engineer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect the control system setup and operation.
- D. Provide a Preliminary TAB report within two weeks of completion. A copy will be provided to the Owner. The report will contain a summary explanation of the assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC or NEBB.
- E. Provide the Owner with any requested data, gathered in accordance with the Project, but not shown on the draft reports as necessary to satisfy USGBC reporting.
- F. Conduct spot checks on all performed balancing for witness by the Owner.
- G. Provide a final electronic TAB report organized in accordance with Project requirements with details. Include all documentation previously identified and / or requested.

1.7 RELATED WORK

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

3.2 STARTUP

- A. The Heating, Ventilating and BAS Work shall clarify start-up responsibility and requirements to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Owner.
- B. Work shall identify responsibility for calibrating all control sensors and equipment.

3.3 CONTRACTOR TESTS

- A. Contractors shall forward to the Owner, through the [CM/GC], a list and schedule of specified contractor tests. The tests shall include at least the following:

Ductwork	Ductwork Testing
AHU's	Startup
Dedicated Outside Air Unit	Startup
Controls	Preparation (calibration)

- B. Unless specified otherwise, provide a minimum 2 week prior notice to the Owner through the General Contractor for each specified Contractors' test.
- C. Submit Contractors' test reports to the Owner, through the *General Contractor* within one week of the successful completion of each test. Contractors shall document and issue a test report for each required test. Individual test reports should be bundled together into a group for submission to the Owner. The test report shall contain all information required by the respective specification section including the test date, start time, stop time, test duration, initial values, final values, expected result, and acceptable test values (per individual specification sections). The person(s) conducting each test and the local code authority (if applicable) shall sign and date each test report indicating that the test has been successfully completed and the results are within acceptable parameters.

3.4 FUNCTIONAL PERFORMANCE (WITNESSED) TESTS

- A. All checkouts, coordination with other Contractors, Work, debugging, preliminary reports including validating coordinated work with BAS, Vent and Heating Contractors shall all have been completed prior to requesting scheduling of Owner witnessing of Functional Testing Procedures.

3.5 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

3.6 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications. Refer to *Section 01 78 23 – Operation and Maintenance Data* and *Section 01 91 13 – General Commissioning Requirements* for additional O&M manual requirements.
- B. Additional BAS O&M Manual Requirements. In addition to documentation that may be specified elsewhere, the BAS Contractor shall compile and organize at minimum the following data on the control system in labeled three-ring binders with indexed tabs.
 - 1. Three copies of the controls training manuals.
 - 2. The O&M manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation
 - b. Control drawings
 - c. Points lists
 - d. Controller/module data
 - e. Thermostats and timers
 - f. Sensors and DP switches
 - g. Valves and valve actuators
 - h. Dampers and damper actuators
 - i. Program setups (software program printouts)
 - 3. Operation and Maintenance Manuals content:
 - a. Specific instructions on how to perform and apply all functions, features, modes, etc., mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
 - b. Full as-built set of control drawings (refer to Submittal section above for details).
 - c. Full as-built sequence of operations for each piece of equipment.
 - d. Full points list.
 - e. Full print out of all schedules and set points after testing and acceptance of the system.
 - f. Full as-built print out of software program.
 - g. Electronic copy on disk of the entire program for this facility.
 - h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
 - i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 - j. Control equipment component submittals, parts lists, etc.
 - k. Warranty requirements.
 - l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 - 4. Field checkout sheets shall be provided to the Owner for inclusion in the Commissioning Record Book (merged with Systems Manual).
- C. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the Owner. Refer to *Section 01 91 13*.

3.7 TRAINING OF OWNER PERSONNEL

- A. The *General Contractor* shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to *Section 01 91 13*.
- B. The Heating and Ventilating Contractors shall have the following additional training responsibilities:
 - 1. Provide the designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of mechanical equipment (pumps, airflow stations, air handling units, fans, cabinet heaters, and controls).
 - 2. Training shall normally start with discussion sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 3. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 4. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise and in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 5. The Contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 - 6. The training sessions shall follow the outline in the table of contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 7. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - 8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
 - 9. The Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central building automation system.
 - 10. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
 - 11. Duration of Training. The contractor shall provide training on each piece of equipment.
- C. The Heating Contractor shall have the following additional training responsibilities:
 - 1. The Contractor shall provide the designated Owner personnel training on the building automation system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the building automation system.

2. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals *and* in all software displays. Manuals will be approved by the Owner. Copies of audiovisuals shall be delivered to the Owner.
3. The training will be tailored to the needs and skill-level of the trainees.
4. The trainers will be knowledgeable on the system and its use in buildings. The Owner shall approve the instructor prior to scheduling the training.
5. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
6. Duration of Training. The Contractor shall provide training on each piece of equipment.

3.8 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the start-up and initial checkout plan, all other Plans, Contractor Tests, the filled out Start-up, all Checkouts such as but not limited to Pre-Functional Checklists, BAS and TAB (trend proofs, I/O value reports logs), Preliminary TAB and Final TAB Reports described herein and in *Section 01 91 00*.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC (ALTERNATE #2)

PART 1- GENERAL

1.1 DESCRIPTION

- A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in Sequence of Operations for HVAC Controls" shall be BACnet objects.

1.2 APPROVED CONTROL SYSTEM MANUFACTURERS

- A. The following are approved control system suppliers, manufacturers, and product lines:

Supplier	Manufacturer	Product Line
JCI – Branch Office	JCI – Noe Salinas	Metasys
Siemens	Siemens	Desigo

1.3 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications

- 1. Installer shall have an established working relationship with Control System Manufacturer.
- 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.4 ARCHITECTURE/COMMUNICATION

- A. The BAS will consist of a New Front End accessible via the World Wide Web and accessible via the Owner's Existing Johnson Controls Application/ Data Server.
- B. Equipment controllers and auxiliary control devices shall conform to:
- C. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
- D. 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.
- E. To maintain robust communication, mesh networking and two-way communications shall be used to optimize the ~~wireless~~ network health.
- F. Certifications shall include FCC CFR47 - RADIO FREQUENCY DEVICES - Section 15.247 & Subpart E
- G. Shall be ZigBee Building Automation Certified to allow ~~wireless~~ integration with products from multiple suppliers.

1.4 GRAPHICS PACKAGE

- A. All floor plan graphics shall be represented in a 3D extruded wall thermograph.
- B. All equipment graphics shall by 3D representations of actual equipment at site.

1.5 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
 - 1. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems
- B. Schedules:
 - 1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations.
 - 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

1.6 WARRANTY

- A. Warrant work as follows:
 - 1. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 - 2. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 - 3. If the engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
 - 4. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
 - 5. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code

5. Documentation

1.8 TRAINING

- A. Provide training for a designated staff of Owner's representatives in two four hour sessions. Training shall be provided via web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - e. Operate the workstation and peripherals
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand system drawings and Operation and Maintenance manual
 - k. Understand the job layout and location of control components
 - l. Access data from DDC controllers and ASCs
 - m. Operate portable operator's terminals

PART -2 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

2.1 SECTION INCLUDES:

- A. Rooftop Units
- B. Fan Powered Box
- C. Variable Air Volume
- D. DX Single Zone Unit
- E. Exhaust Fan
- F. Motorized Dampers
- G. Lighting Controls via BACnet (Alternate)

2.2 ROOFTOP UNITS (RTU-A1 thru C3)

Building Automation System Interface:

The Building Automation System (BAS) shall send the controller Occupied Bypass, Pre-Cool, Occupied / Unoccupied and Heat / Cool modes. If a BAS is not present, or communication is lost with the BAS the RTU controller shall operate using default modes and setpoints.

Occupied Mode:

During occupied periods, the supply fan shall run continuously and the outside air damper shall open to maintain minimum ventilation requirements. The unit controller shall control the supply fan VFD to maintain the current duct static pressure setpoint (adj.). The DX cooling shall stage to maintain the current discharge air temperature setpoint. If economizing is enabled the outside air damper shall modulate to maintain the current discharge air temperature setpoint.

Unoccupied Mode:

When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F (adj.) the supply fan variable frequency drive (VFD) shall operate as necessary to maintain duct static pressure setpoint (adj.), the outside air damper shall open if economizing is enabled and remain closed if economizing is disabled and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0

deg. F minus the unoccupied differential of 4.0 deg. F (adj.) the supply fan shall stop, the DX cooling shall be disabled and the outside air damper shall close.

Optimal Start:

The BAS shall monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Pre-Cool Mode:

During optimal start, if the average space temperature is above the occupied cooling setpoint, pre-cool mode shall be activated. When pre-cool is initiated the unit shall enable the fan and cooling or economizer. The outside air damper shall remain closed, unless economizing. When the average space temperature reaches occupied cooling setpoint (adj.), the unit shall transition to the occupied mode.

Optimal Stop:

The BAS shall monitor the scheduled unoccupied time, occupied setpoints and space temperature to calculate when the optimal stop occurs. When the optimal stop mode is active the unit controller shall maintain the space temperature to the space temperature offset setpoint.

Occupied Bypass:

The BAS shall monitor the status of the "on" and "cancel" buttons of the space temperature sensors. When an occupied bypass request is received from a space sensor, the unit shall transition from its current occupancy mode to occupied bypass mode and the unit shall maintain the space temperature to the occupied setpoints (adj.).

Cooling Mode:

The unit controller shall use the discharge air temperature sensor and discharge air temperature cooling setpoint to determine when to initiate requests for cooling. Discharge air setpoint shall be maintained by modulating the economizer or staging the DX cooling as required to maintain the discharge air setpoint.

Supply Air Temperature Reset Control:

The discharge air temperature setpoint, 55.0 deg. F - 65.0 deg. F (adj.) shall be reset based on either the outside air temperature or space average temperature (adj.). The minimum discharge air setpoint shall be set at 55.0 deg. F (adj.). The discharge temperature sensor shall prevent the discharge air temperature from falling below the minimum discharge air setpoint (adj.). If the discharge air temperature continues to fall, the discharge temperature sensor shall act as a low discharge temperature limit, a low temperature alarm shall be annunciated, and the unit shall shut down. If the discharge temperature rises above the high limit setpoint the sensor shall act as a high discharge temperature limit and shall keep the unit running, a high temperature alarm shall be annunciated.

Outdoor Air Temperature Reset:

The discharge air temperature setpoint shall be adjusted based on the outside air temperature and the cooling load of the building.

Space Temperature Reset:

The discharge air temperature setpoint shall be adjusted based on the temperature of the critical space(s).

Economizer:

The supply air sensor shall measure the dry bulb temperature of the air leaving the evaporator coil while economizing. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The economizer damper shall modulate toward minimum position in the event the mixed air temperature falls below the low limit temperature setting. Compressors shall be delayed from operating until the economizer has opened to 100%.

Supply Fan:

The supply fan shall be enabled while in the occupied mode and cycled on during the unoccupied mode. A differential pressure switch shall monitor the differential pressure across the fan. If the switch does not open

within 40 seconds after a request for fan operation a fan failure alarm shall be annunciated at the BAS, the unit shall stop, requiring a manual reset.

Critical Zone Reset (Static Pressure Control):

The duct static pressure setpoint shall be reset to the optimal setpoint communicated by the BAS. The BAS shall reset the duct static pressure setpoint based on the position of the furthest open VAV damper. The supply duct static pressure sensor shall also act as a high duct static pressure safety and shall shut down the unit in the event that the duct static pressure reaches 3.00 inches of W.C. (adj.). A manual reset shall be required to re-start the unit. When the unit is in the unoccupied mode the controller shall modulate the speed of the VFD to 50%. If the duct static pressure sensor fails, the VFD shall modulate its speed to 50% and an alarm shall be annunciated at the BAS.

Filter Status:

A differential pressure switch shall monitor the differential pressure across the filter when the fan is running. If the switch closes for 2 minutes after a request for fan operation a dirty filter alarm shall be annunciated at the BAS.

2.3 NA

2.5 DX SINGLE ZONE UNIT

Run Conditions – Scheduled through BAS:

The unit shall be controlled using a BACnet communicating thermostat.

Alarms shall be provided as follows:

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

The supply fan shall run anytime the unit is commanded to run, unless shutdown on internal safeties.

Cooling Stages:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint.

Electric Heating Stages:

The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint.

2.6 MISCELLANEOUS CONTROL POINTS

Outdoor Air Temperature and Humidity:

A temperature and humidity sensor mounted on the north side of the building will continually broadcast their information on the network as global information

Building Exhaust Fan:

When any RTU is active the BAS will energize the exhaust fan. The exhaust fan will be off when the RTU is inactive.

Temperature monitor of elevator equipment room served by minisplits. Alarms shall be provided as follows:

High Temp: When temp is above user defined setpoint an alarm will be initiated.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:

1.2 REFERENCES

A. Association Publications:

1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
 - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
 - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.

B. Definitions:

1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

C. Reference Standards:

1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ANSI/ASHRAE Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
 - b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.
2. American National Standards Institute / American Welding Society:
 - a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. '2011 ASHRAE Handbook - HVAC Applications'.
 - 1) Chapter 48, 'Noise and Vibration Control'.
4. ASTM International:
 - a. ASTM A36/A36M-08, 'Standard Specification for Carbon Structural Steel'.
 - b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.

- 5. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
- 6. Underwriters Laboratories:
 - a. UL 2182, 'Refrigerants' (2nd Edition).

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Show each individual equipment and piping support.
- B. Informational Submittals:
 - 1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Refrigerants:
 - a. Underwriters Laboratories / Underwriters Laboratories of Canada:
 - 1) Comply with requirements of UL 2182.
- B. Qualifications. Section 01 4301 applies, but is not limited to the following:
 - 1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Airtec,
 - b. Cush-A-Clamp by ZSI Manufacturing,
 - c. Elkhart Products Corp.,
 - d. Emerson Climate Technologies,
 - e. Handy & Harman Products
 - f. Harris Products Group,
 - g. Henry Valve Co,
 - h. Hilti Inc,
 - i. Hydra-Zorb Co,
 - j. JB Industries,
 - k. Mueller Steam Specialty,
 - l. Nibco Inc,
 - m. Packless Industries, Parker Corp,
 - n. Sporlan Valve Co.
 - o. Sherwood Valves,.
 - p. Thomas & Betts,
 - q. Unistrut, Div of Atkore International, Inc.
 - r. Universal Metal Hose.
 - s. Vibration Mountings & Controls,
 - t. Virginia KMP Corp,
- B. Materials:
 - 1. Refrigerant Piping:
 - a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.

- b. Do not use pre-charged refrigerant lines.
- 2. Refrigerant Fittings:
 - a. Wrought copper with long radius elbows.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 3. Suction Line Traps:
 - a. Manufactured standard one-piece traps.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 4. Tee Access:
 - a. Brass:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
- 5. Connection Material:
 - a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
 - 1) Copper to Copper Connections:
 - a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
 - 3) Do not use rods containing Cadmium.
 - b. Flux:
 - 1) Type Two Acceptable Products:
 - a) Stay-Silv White Brazing Flux by Harris Products Group.
 - b) High quality silver solder flux by Handy & Harmon.
 - c) Equal as approved by Architect before use. See Section 01 6200.
- 6. Valves:
 - a. Expansion Valves:
 - 1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - 2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
 - 3) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Emerson Climate Technologies.
 - b) Henry.
 - c) Mueller.
 - d) Parker.
 - e) Sporlan.
 - b. Manual Refrigerant Shut-Off Valves:
 - 1) Ball valves designed for refrigeration service and full line size.

- 2) Valve shall have cap seals.
- 3) Valves with hand wheels are not acceptable.
- 4) Provide service valve on each liquid and suction line at compressor.
- 5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
- 6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Henry.
 - b) Mueller.
 - c) Sherwood.
 - d) Virginia.
7. Filter-Drier:
 - a. On lines **3/4 inch (19 mm)** outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than **3/4 inch (19 mm)** outside diameter, filter-drier shall be sealed type with brazed end connections.
 - c. Size shall be full line size.
 - d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Emerson Climate Technologies.
 - 2) Mueller.
 - 3) Parker.
 - 4) Sporlan.
 - 5) Virginia.
8. Sight Glass:
 - a. Combination moisture and liquid indicator with protection cap.
 - b. Sight glass shall be full line size.
 - c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
 - d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) HMI by Emerson Climate Technologies.
9. Flexible Connectors:
 - a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Vibration Absorber Model VAF by Packless Industries.
 - 2) Vibration Absorbers by Virginia KMP Corp.
 - 3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
 - 4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
10. Refrigerant Piping Supports:
 - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
 - b. Securing Channels:
 - 1) At Free-Standing Pipe Support:
 - a) Class One Quality Standard: P-1000 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 2) At Wall Support:

- a) Class One Quality Standard: P-3300 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- 3) At Suspended Support:
 - a) Class One Quality Standard: P-1001 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- 4) Angle Fittings:
 - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- c. Pipe Clamps:
 - 1) Type Two Acceptable Manufacturers:
 - a) Hydra-Zorb.
 - b) ZSI Cush-A-Clamp.
 - c) Hilti Cush-A-Clamp.
 - d) Equal as approved by Architect before installation. See Section 01 6200.
- d. Protective Cover: 18 ga (1.2 mm) steel, hot-dipped galvanized.
- 11. Locking Refrigerant Cap:
 - a. Provide and install on charging valves:
 - 1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
 - 2) Acceptable Manufacturers: Airtec.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refrigerant Lines:
 - 1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
 - 2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters). Locate traps at vertical rises against flow in suction lines.
- B. Connections:
 - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
 - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
 - 3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.
- C. Specialties:
 - 1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
 - 2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
 - 3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
 - 4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:

1. Support Spacing:

- a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
 - b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
 - c. Support each elbow.
2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
 - b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
 - c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
 - d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
 - e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
 - f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:

1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

SECTION 23 26 00

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:

1. ASTM International:
 - a. ASTM B88-09, 'Standard Specification for Seamless Copper Water Tube'.
 - b. ASTM D1785-12, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:

1. Condensate Drains:
 - a. Exterior And Interior Lines: Type M copper meeting requirements of ASTM B88.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensate Drains:

1. Support piping and protect from damage.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- B. 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

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 $\text{Btu} \times \text{in.}/\text{h} \times \text{sq. ft.} \times \text{deg F}$ or $\text{W}/\text{m} \times \text{K}$ 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.
 - 4. Coordination with other trades and including but not limited to: structural members, electrical lights and conduits, plumbing lines, & fire sprinkler lines.
- 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- thick, galvanized sheet for concealed ducts and 0.0500-inch- 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- 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.
 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 ,negative pressure.
 4. Exhaust Ducts: 1-inch wg negative pressure.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. 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.

2.6 DUCT STORGE

- A. All duct must have end capped with plastic covers on both ends from end of fabrication to duct installation. If this is not provided at the field, vacuum ducts before final acceptance to remove dust and debris.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division 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 Section "Duct Accessories." Firestopping materials and installation methods are specified in other Divisions

3.2 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 transverse joints, longitudinal seams and duct wall penetrations 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.

3.3 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F 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 intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

3.4 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

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 of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet 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 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 DUCT APPLICATION

- A. Service: Round and rectangular, supply/return/outside -air ducts, concealed.
- B. Sheet-metal with wrap insulation
- C. Service: Round and rectangular, supply/return/outside -air ducts, exposed and in mechanical rooms.
 - 1. Sheet-metal double wall with lined insulation in-between.
 - 2. Inner sheet-metal duct shall be perforated in areas with acoustical requirements, ref. plans.

3.8 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, when applicable) 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 (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.
- E. Remake leaking joints and retest until leakage is less than maximum allowable.

3.9 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system.

END OF SECTION

SECTION 23 33 00

HVAC DUCT ACCESSORIES

PART 1 - GENERAL

1.1 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.

1.2 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.

1.3 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."

1.4 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 "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 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:

1. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
2. Underwriters Laboratories:
 - a. UL 181, 'Factory-Made Ducts and Air Connectors' (10th Edition).
 - b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:

- a. Anco Products Inc,
- b. Thermaflex by Flexible Technologies
- c. Flexmaster USA Inc, Houston, TX

B. Materials:

1. Ducts:

- a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
- b. Insulation:
 - 1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
- c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
- d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) ANCO-FLEX 4625 by Anco Products.
 - 2) M-KC by Thermaflex by Flexible Technologies.
 - 3) Type 4m Insulated by Flexmaster.

2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.

PART 3 - EXECUTION

3.1 INSTALLATION

- ###### A. Install duct in fully extended condition free of sags and kinks, using 60 inch maximum lengths.

- B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes centrifugal fans and vent sets.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA standards.

1.3 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 specifications.

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.
- 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.

1.5 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.

1.6 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 these 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.
 - 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 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 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 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 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 specifications Section "Closeout Procedures."
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 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.

1.3 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.

1.4 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 23 74 10

PACKAGED ROOFTOP UNITS

PART 1: GENERAL

1.01 SECTION INCLUDES

- A. Packaged Rooftop air conditioners

1.02 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99—Standards Handbook
- C. AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes
- D. AMCA 500—Test Methods for Louver, Dampers, and Shutters.
- E. AHRI 340/360 - Unitary Large Equipment
- F. NEMA MG1—Motors and Generators
- G. National Electrical Code.
- H. NFPA 70—National Fire Protection Agency.
- I. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
- J. UL 900—Test Performance of Air Filter Units.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- B. Product Data:
 - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, and electrical characteristics and connection requirements.
 - 2. Provide computer generated fan curves with specified operating point clearly plotted.
 - 3. Manufacturer's Installation Instructions.

1.04 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Provide instructions for installation, maintenance and service

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.
- B. Startup must be done by trained personnel experienced with rooftop equipment.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site and inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

PART 2: PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Daikin Applied
- B. Alternative acceptable manufacturers:
 - 1. Trane
 - 2. Carrier
 - 3. Lennox

2.02 GENERAL DESCRIPTION

- A. Furnish as shown on plans, Daikin Applied Rebel Single zone Heating and Cooling Unit(s) model DPS. Unit performance and electrical characteristics shall be per the job schedule.
- B. Configuration: Fabricate as detailed on prints and drawings:
 - 1. Return plenum / economizer section
 - 2. Filter section
 - 3. Cooling coil section
 - 4. Supply fan section
 - 5. Condensing unit section
- C. The complete unit shall be cETLus listed.
- D. The unit shall be ASHRAE 90.1-2016 compliant and labeled.
- E. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.
- F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
- G. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- H. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.
- I. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

2.03 CABINET, CASING, AND FRAME

- A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
- B. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat.

Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16" at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.

C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.04 OUTDOOR/RETURN AIR SECTION

A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in accordance with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.

B. Provide a field installed Duct/Space mounted CO2 sensor. Outside air damper position will modulate between the Demand Control Ventilation Limit (minimum position setpoint) and the Ventilation Limit (maximum non-economizer position setpoint) to satisfy the space requirements. Damper position will be controlled to the greater of the two command signals, either minimum outside air flow or space IAQ (CO2).

C. Economizer assembly Fault Detection and Diagnostics (FDD) shall be 90.1, IECC, and California Title 24 compliant. MicroTech III controls shall display a warning, and write a warning to the BAS, if the economizer malfunctions in accordance with 90.1, IECC, and Title 24 specifications.

2.05 FILTERS

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 construction filters and 4"

MERV 13 filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.06 COOLING COIL

A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

2.07 HOT GAS REHEAT

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

D. Each coil shall be factory leak tested with high-pressure air under water.

2.08 SUPPLY FAN

A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

C. Supply fan and motor assembly combinations larger than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.

D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of

excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.09 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.

C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25°

F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite materia

E. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

G. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

H. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.010 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be

provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.011 CONTROLS

A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

1. Return air temperature.
2. Discharge air temperature.
3. Outdoor air temperature.
4. Space air temperature.
5. Outdoor enthalpy, high/low.
6. Compressor suction temperature and pressure
7. Compressor head pressure and temperature
8. Expansion valve position

9. Condenser fan speed
 10. Inverter compressor speed
 11. Dirty filter indication.
 12. Airflow verification.
 13. Cooling status.
 14. Control temperature (Changeover).
 15. VAV box output status.
 16. Cooling status/capacity.
 17. Unit status.
 18. All time schedules.
 19. Active alarms with time and date.
 20. Previous alarms with time and date.
 21. Optimal start
 22. Supply fan and exhaust fan speed.
 23. System operating hours.
 - a. Fan
 - b. Exhaust fan
 - c. Cooling
 - d. Individual compressor
 - e. Heating
 - f. Economizer
 - g. Tenant override
- G. The user interaction with the keypad shall provide the following:
1. Controls mode
 - a. Off manual
 - b. Auto
 - c. Heat/Cool
 - d. Cool only
 - e. Heat only
 - f. Fan only
 2. Occupancy mode
 - a. Auto
 - b. Occupied
 - c. Unoccupied
 - d. Tenant override
 3. Unit operation changeover control
 - a. Return air temperature
 - b. Space temperature
 - c. Network signal
 4. Cooling and heating change-over temperature with deadband
 5. Cooling discharge air temperature (DAT)
 6. Supply reset options
 - a. Return air temperature
 - b. Outdoor air temperature
 - c. Space temperature

- d. Airflow (VAV)
- e. Network signal
- f. External (0-10 vdc)
- g. External (0-20 mA)
- 7. Temperature alarm limits
 - a. High supply air temperature
 - b. Low supply air temperature
 - c. High return air temperature
- 8. Lockout control for compressors.
- 9. Compressor interstage timers
- 10. Night setback and setup space temperature.
- 11. Building static pressure.
- 12. Economizer changeover
 - a. Enthalpy
 - b. Drybulb temperature
- 13. Currently time and date
- 14. Tenant override time
- 15. Occupied/unoccupied time schedule
- 16. One event schedule
- 17. Holiday dates and duration
- 18. Adjustable set points
- 19. Service mode
 - a. Timers normal (all time delays normal)
 - b. Timers fast (all time delays 20 sec)
- H. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
 - 1. Zone sensor with tenant override switch
 - 2. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)
- I. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
 - 1. Airflow
 - 2. Outside air temperature
 - 3. Space temperature
 - 4. Return air temperature
 - 5. External signal of 1-5 vdc
 - 6. External signal of 0-20 mA
 - 7. Network signal

2.012 ROOF CURB

- A. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete

perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

END SECTION

SECTION 26 00 00

ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Specification Sections and other 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, disconnect, fire alarm, rough-in for telephone and data 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. 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 26 01 20

OPERATION AND MAINTENANCE OF LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART1- GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Specification Sections and all relevant documents shall form a part of this Section of the Specifications, and shall be incorporated in this Section and each Section 260000 hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Section. Certain specific paragraphs of said references may be referred to hereinafter in this Section. 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 Section 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 these Specifications.
- B. The work covered by this Section 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 Sections of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Section 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 Section of the Specifications. The Contractor shall specifically and distinctly assume, and does zeso 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 Section, 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 Section of the Specifications be similarly furnished, installed and connected under this Section, 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 Section 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 Section as related to the work of all other Sections 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 Section.

1.11 SUBMITTALS

- A. Submit product data and shop drawings in accordance with 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 Section with the work of other Sections, 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 Section.
- 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 Section in strict accordance with the applicable provisions of Section, 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, provided a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 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 Section 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 SECTION'S EQUIPMENT

- A. Verify the electrical requirements of all equipment furnished under other Sections, 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 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. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with lemon-oil rag after all other cleaning is complete. 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 copies 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 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

EMT: Electrical metallic tubing.

FMC: Flexible metal conduit.

IMC: Intermediate metal conduit.

LFMC: Liquidtight flexible metal conduit.

RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

Product Data: For electricity-metering equipment.

Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

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.

Comply with NFPA 70.

1.6 COORDINATION

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.

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.

Coordinate electrical service connections to components furnished by utility companies.

2. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
3. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Section "Access Doors."

Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.7 PRODUCTS

1.8 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

Meter Sockets: Comply with requirements of electrical power utility company.

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,
3. minimum.

1.9 CONCRETE BASES

Concrete Forms and Reinforcement Materials: As specified in Section "Cast-in-Place Concrete."

Concrete: 3000-psi, 28-day compressive strength as specified in Section "Cast-in-Place Concrete."

1.10 TOUCHUP PAINT

For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PRODUCTS

EXECUTION

1.11 ELECTRICAL EQUIPMENT INSTALLATION

Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

Right of Way: Give to raceways and piping systems installed at a required slope.

1.12 RACEWAY AND CABLE INSTALLATION

Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

Use temporary raceway caps to prevent foreign matter from entering.

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.

Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch 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 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.

Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet 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.

Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

Set floor boxes level and trim after installation to fit flush to finished floor surface.

1.13 ELECTRICAL SUPPORTING DEVICE APPLICATION

Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

Dry Locations: Steel materials.

Support Clamps for PVC Raceways: Click-type clamp system.

Selection of Supports: Comply with manufacturer's written instructions.

Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

1.14 SUPPORT INSTALLATION

Install support devices to securely and permanently fasten and support electrical components.

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.

Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

Install 1/4-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.

Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

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.

Simultaneously install vertical conductor supports with conductors.

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 from the box.

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.

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.

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.

1.15 IDENTIFICATION MATERIALS AND DEVICES

Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

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.

Self-Adhesive Identification Products: Clean surfaces before applying.

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 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 maximum intervals in straight runs, and at 25-foot 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.

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.

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 below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

4. Phase A: Black.
5. Phase B: Red.
6. Phase C: Blue.
7. Neutral: White.
8. Ground: Green.

Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

9. Phase A: BROWN.
10. Phase B: ORANGE.
11. Phase C: YELLOW.
12. Neutral: White with a colored stripe or gray.
13. Ground: Green.

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.

Install engraved-laminated emergency-operating signs with white letters on red background with

minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

1.16 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

1.17 FIRESTOPPING

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 Section "Firestopping."

1.18 CONCRETE BASES

Construct concrete bases of dimensions indicated, but not less than 4 inches 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, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete."

1.19 CUTTING AND PATCHING

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.

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.

1.20 FIELD QUALITY CONTROL

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.

Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.

10. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
11. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
12. 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.

13. 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.
14. 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.

1.21 REFINISHING AND TOUCHUP PAINTING

Refinish and touch up paint. Paint materials and application requirements are specified in Section "Painting."

Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

1. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

1.22 CLEANING AND PROTECTION

1. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
2. 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 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTOR AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and 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 Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
- H. Identify wires and cables according to Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to 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 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and 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. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

- A. Revise this Article to suit Project and office practice. Frequently, no product submittal is required for this Section.
- B. Product Data: For each type of product indicated.
- C. Retain paragraph above if Product Data are required for each product specified. Retain paragraph below if Product Data are required only for selected products.
- D. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical rods.
 - 3. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. 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. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency. Delete if Contractor is allowed to perform ground-resistance testing.
- 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.
 - 1. Comply with UL 467.

- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. 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. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. 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 Section "Conductors and Cables."
- B. If only copper conductors are permitted in Division 16 Section "Conductors and Cables," delete paragraph below.
- C. Material: copper.
- D. Equipment Grounding Conductors: Insulated with green-colored insulation.

- E. 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.
 - F. Grounding Electrode Conductors: Stranded cable.
 - G. Underground Conductors: stranded, unless otherwise indicated.
 - H. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
 - I. 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.
 - J. Delete paragraph and subparagraphs below if use of aluminum conductors is not permitted.
 - K. 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.
 - L. 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. Copper-clad steel is most common. See Evaluations for discussion on where other materials might be more appropriate.
 - B. Ground Rods: Copper-clad steel.
 - 1. Select paragraph above or paragraph and subparagraph below. Sectional types are used when rods longer than 10 feet (3 m) are installed.
 - 2. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
 - C. 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.
 - D. Test Wells: Provide handholes as specified in Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Delete paragraph below if only copper conductors are specified in Division 16 Section "Conductors and Cables."

- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. In raceways, use insulated equipment grounding conductors.
- D. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- F. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- G. Delete paragraph and subparagraphs below if grounding bus is not required, or edit to suit Project.
- H. 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.
- I. Edit below to suit Project.
- J. 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. NEC permits two basic types of equipment grounding conductors: metallic raceway or cable sheath as the conductor, or a separate equipment grounding conductor. The installation of an equipment grounding conductor provides an additional degree of safe operation when compared to relying on raceway as the conductor. Revise paragraphs and subparagraphs in this Article to suit Project.
- B. 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.
- C. Install equipment grounding conductors in all feeders and circuits.
- D. Select paragraph above or paragraph and subparagraphs below.
- E. 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.
- F. 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.

- G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- H. 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.
- I. 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.
- J. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- K. 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.
- L. 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.
- M. Coordinate paragraph and subparagraphs below with Drawings and Specification Sections for systems referenced. Edit to suit Project.
- N. 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.
- O. 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. Coordinate paragraph and subparagraphs below with Drawings.
- B. 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.
- C. 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.

- D. 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.
- E. 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.
- F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- G. 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.
- H. 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.
- I. 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. Retain one of three paragraphs below.
- B. 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. NFPA 70 has minimum value of 25 ohms. See Evaluations for discussion on appropriate grounding resistance values. Values listed below are typical; adjust to suit Project conditions.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.

- d. Equipment Rated More Than 1000 kVA: 3 ohms.
 - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - f. 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. Delete below if inappropriate or if surface restoration work is covered on Drawings or in Division 2 Sections. Coordinate with Drawings.
- B. 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 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with this sections, as applicable. Refer to other sections 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

- A. Unistrut Corp.
- B. B-Line Systems, Inc.
- C. Midland Ross-Kindorf

2.2 MATERIALS

- A. Suspension Hangers
 - 1. Suspension hangers for individual conduit runs shall be zinc plated formed steel type.
- B. Vertical Supports
 - 1. Malleable iron one hole pipe straps shall be used for vertical runs
- C. Clamps
 - 1. Beam clamps shall be used for bar joists and beams.
- D. Anti-Vibration Hangers
 - 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 26 51 00
- B. Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside.Z

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:

B. NOMINAL CONDUIT SIZE ROD DIAMETER

1/2" through 2 1/4"

2-1/2" through 3 3/8"

4" and 5 1/2"

1. 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".
2. Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.
3. Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

Supports

4. Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.
5. Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.
6. 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.
7. Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.
8. Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.
9. 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 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Edit lists below to suit Project.
 - 2. 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.
 - 3. 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. List below only products and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that Section titles listed below are correct for this Project's Specifications because Section titles may have changed since this Section was updated.
 - 2. Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 3. 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. Delete below except for custom enclosures.
- C. 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. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflec 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. Select 1 of 4 paragraphs below.
 - E. Wireway Covers: Screw – cover type flanged-and-gasketed type.
 - F. Finish: Manufacturer's standard enamel finish.
- 2.5 OUTLET AND DEVICE BOXES
- A. Sheet Metal Boxes: NEMA OS 1.

- B. Edit paragraph below. Aluminum is also available and suitable for use with steel raceways.
- C. 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. Use a comprehensive wiring method schedule on Drawings or use this Article to specify where various raceway types are to be installed. Edit examples below, adding or deleting materials and methods to suit Project. Coordinate with Division 16 Section "Wires and Cables." Do not duplicate information on Drawings, in NFPA 70, or in other Division 16 Sections. List exceptions to stated requirements. Check code to avoid specifying uses not permitted.
- B. 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 .
- C. 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. Select 1 of 2 subparagraphs below and add other specific box and enclosure requirements to suit Project.
 - b. 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. Select paragraph above or below.
- C. Minimum Raceway Size: **3/4-inch trade size (DN21)**.
- D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. 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.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- I. Use temporary closures to prevent foreign matter from entering raceways.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. 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.
- L. 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.
- M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- N. 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.
- O. 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.
- P. 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.
- Q. Tighten set screws of threadless fittings with suitable tools.
- R. 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.

- S. 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.
- T. 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.
- U. 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.
- V. Delete paragraph below if not applicable.
- W. 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.
- X. 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.
- Y. 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.
- Z. Delete paragraph below if no high-frequency installation.
- AA. 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.
- BB. Do not install aluminum conduits embedded in or in contact with concrete.
- CC. 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.
- DD. 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.

EE. Set floor boxes level and adjust to finished floor surface.

FF. Select paragraph above for metal floor boxes and below for nonmetallic floor boxes.

GG. Set floor boxes level and trim after installation to fit flush to finished floor surface.

HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

- II. 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 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART1 -GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and 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 Section 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 sections 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. Contractor is responsible to call 811 prior to any work. 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 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with ELECTRICAL Sections, as applicable. Refer to other sections 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.
 - 3. 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.
 - 4. Wiring devices.
 - 5. Wiring.
 - 6. Three phase motor rotation.

1.3 SUBMITTALS

- A. Submit product data in accordance with Section for products specified under PART 2 - PRODUCTS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Brady
- B. Panduit
- C. Thomas & Betts
- D. Seton

2.2 IDENTIFICATION

- E. 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 section identification as to its given name, voltage and origination of service. Examples are as follows:

‘LR1’
120/240V
FED FROM ‘MDP’

‘LR2’
120/240V
FED FROM ‘MDP’

'AHU-1' 'CU-1'
FED FROM 'MDP' FED FROM 'MDP'

4. Provide for each feeder protective device in each distribution panelboard and any other similar equipment furnished under this section, 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.
- F. B. Junction Boxes and Pull Boxes
1. 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.
- G. C. Wiring Device Wall Plates
1. 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.
- H. D. Wire Markers
1. 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.
- I. 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

- J. A.Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this section.

3.3 WIRE MARKERS

- K. 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 26 05 73

POWER SYSTEM STUDIES

PART 1 -GENERAL

1.1 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - 5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code, latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.
- B. The report shall include the following sections:

1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
2. Descriptions, purpose, basis and scope of the study
3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
5. Multi-function relay setting file printouts including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.
6. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
7. Incident energy and flash protection boundary calculations
8. Comments and recommendations for system improvements, where needed
9. Executive Summary including source of information and assumptions made

1.5 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 PRODUCT

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.5 and Informative Annex D.

2.2 DATA COLLECTION

- A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future utility supplies, motors, and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Typical calculations
 - 6. Tabulations of calculated quantities
 - 7. Results, conclusions, and recommendations
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - 1. Electric utility's supply termination point
 - 2. Incoming switchgear
 - 3. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers
 - 6. Standby generators and automatic transfer switches
 - 7. Branch circuit panelboards
 - 8. Other significant locations throughout the system
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses
 - 3. Adequacy of transformer windings to withstand short-circuit stresses
 - 4. Cable and busway sizes for ability to withstand short-circuit heating
 - 5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the curve sheets, where applicable:
 - 1. Electric utility's protective device
 - 2. Medium voltage equipment relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

6. Conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
 - G. Select each primary protective device required for a delta-wye connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter equivalent to 58% of the ANSI withstand point to afford protection for secondary line-to-ground faults.
 - H. Separate low voltage power circuit breakers from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
 - I. Engineer shall provide settings file printouts for all multifunction relays supplied under this contract including all ANSI protective relay functions and associated logic and control. Metering, communication, and control logic settings not associated with ANSI protective functions are not required.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2012, Informative Annex D.
- B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- D. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2 .
- F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
- I.

2.6 REPORT SECTIONS

- A. Input Data:
 1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
 2. Short-circuit reactance of rotating machines with associated X/R ratios
 3. Cable type, construction, size, # per phase, length, impedance and conduit type
 4. Bus duct type, size, length, and impedance
 5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
 6. Reactor inductance and continuous ampere rating
 7. Aerial line type, construction, conductor spacing, size, # per phase, and length
- B. Short-Circuit Data:
 1. Source fault impedance and generator contributions

2. X to R ratios
3. Asymmetry factors
4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents
- C. Recommended Protective Device Settings:
 1. Phase and Ground Relays:
 - a. Current transformer ratio.
 - b. Current setting.
 - c. Time setting.
 - d. Instantaneous setting.
 - e. Specialty non-overcurrent device settings.
 - f. Recommendations on improved relaying systems, if applicable.
 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground).
 - b. Adjustable time-current characteristic.
 - c. Adjustable instantaneous pickup.
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and arc flash boundary calculations.
 1. Arcing fault magnitude
 2. Device clearing time
 3. Duration of arc
 4. Arc flash boundary
 5. Working distance
 6. Incident energy
 7. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.
- D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 in. x 4 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The label shall have an orange header with the wording, "WARNING, SHOCK & ARC FLASH HAZARD", and shall include the following information:
 1. Location designation
 2. Nominal voltage
 3. Arc flash boundary
 4. Incident energy
 5. Working distance
 6. Shock Boundaries

- 7. Engineering report number, revision number and issue date
- C. Labels shall be machine printed, with no field markings
- D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
 - 2. For each motor control center, one arc flash label shall be provided
 - 3. For each low voltage switchboard, one arc flash label shall be provided
 - 4. For each switchgear, one flash label shall be provided
 - 5. For medium voltage switches one arc flash label shall be provided
- E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

- A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

SECTION 26 09 26

LIGHTING 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.

MLO Mode		State of load after each pushbutton press			
		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 ½" 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

NoI

SPR

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)

H. 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

I. 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)

J. 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 filed 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 for minimum of 8-hours and training shall be recorded by the 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 be-bugging, 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 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and 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. Edit panelboards below to suit Project.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Distribution panelboards.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Retain subparagraph below if Project includes fusible panelboards.
 - 3. Section "Fuses."

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. 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. Delete subparagraph below if series rating of overcurrent protective devices is not used.
 - e. UL listing for series rating of installed devices.

f. 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. Delete paragraph below if independent testing agency is not used.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. 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.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in other sections. In addition to requirements specified in 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. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Edit below to delete or add types of equipment that affect panelboard installation.

B. 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. Extra materials may not be allowed for publicly funded projects. Revise quantity below to suit Project.

B. 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. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lists below are examples only. Retain or insert only those manufacturers whose products correspond with other requirements and whose availability and suitability for the application have been verified.

2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton

b. Square D Co.

- c. General Electric
- d. Siemens

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. Delete items below if not applicable. Add other Project-specific requirements.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
 - 5. 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. Retain paragraph above or below.
- D. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- G. Bus: Hard-drawn copper, 98 percent conductivity.
- H. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.
- I. Ten paragraphs below are special features. Add other required features and coordinate with Drawings.
- J. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- K. Delete paragraph below except for panelboards incorporating one or more main service disconnect switches. Edit to suit Project.
- L. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- M. Delete paragraph below if future provisions are not required.
- N. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
- O. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- P. Split Bus: Vertical buses divided into individual vertical sections.
- Q. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- R. Gutter Barrier: Arrange to isolate individual panel sections.
- S. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- T. 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. Select one of two paragraphs below for series-rated system or system that has panelboards and circuit breakers rated for full value of short-circuit current available at location of equipment. Edit to suit Project and coordinate with Drawings.

B. 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. Coordinate below with Drawings.

C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with Drawings.

B. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

C. Main Overcurrent Protective Devices: Circuit breaker.

D. 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. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with schedules and Drawings.

B. 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.

C. 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.

D. 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. Revise paragraph below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- E. 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.
- F. Install filler plates in unused spaces.
- G. Revise below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Select Division 16 Section "Basic Electrical Materials and Methods" for projects with simple requirements and Division 16 Section "Electrical Identification" for projects with complex requirements.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods" [Electrical Identification].
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Coordinate paragraphs below with Drawings.
- B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A 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 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. Retain abbreviations that remain after this Section has been edited for Project.
- B. GFI: Ground-fault circuit interrupter.
- C. 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. Include sample review below if products may have critical features needing hands-on appraisal.
- D. Samples: For devices and device plates for color selection and evaluation of technical features.
- E. Maintenance Data: For materials and products to include in maintenance manuals specified in other sections.

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. Delete paragraph below unless receptacles for Owner-Furnished equipment with plugs have unknown configurations.
- B. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- C. 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. Select one of three paragraphs below to specify grade of receptacles. See Editing Instruction No. 3 in the Evaluations for wiring device grades.
- B. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
- C. Special Receptacles for NEMA configuration refer to Manufacturer specs.
- D. Termination-type GFCI unit may be substituted for feed-through type where no protection of downstream receptacles is required.
- E. 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.
- F. 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.
 - 2. Devices: Listed and labeled as isolated-ground receptacles.
 - 3. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 SWITCHES

- A. General
 - 1. Switches shall be toggle 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.
 - 2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
 - 3. 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. Modify subparagraph below to suit preference.
 - 2. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
 - 3. 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.
 - 4. Plate-Securing Screws: Metal with head color to match plate finish.
 - 5. Select one of five subparagraphs below. Coordinate with Division 9 Section "Painting."
 - 6. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
 - 7. Select one of three subparagraphs below or delete all.
 - 8. Material for Unfinished Spaces: stainless steel.

2.5 FLOOR SERVICE FITTINGS

- A. Items in this Article are available for telephone and data cable service as well as power. Edit to suit Project.
- B. Select one of three paragraphs below.
- C. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

- D. 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. Coordinate two paragraphs below with Drawings.
- F. 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.
- G. Protect devices and assemblies during painting.
- H. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
- I.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
- B. Select paragraph above or below.
- C. Comply with 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. Select paragraph above or below. Coordinate with Division 16 Section "Grounding."
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- D. 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. Paragraph below if GFCIs are not in Part 2.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. 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 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.

1.3 SUBMITTALS

- A. Use this Article to convey basic design intent. Delete if Drawings show sufficient detail to clarify intent.
- B. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
- C. Product Data for each fuse type specified.
- D. Select above or below. Data listed in paragraph below are appropriate where selective coordination is necessary.
- E. Field test reports indicating and interpreting test results.
- F. Maintenance data for tripping devices to include in the operation and maintenance manual specified in other sections.

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. Subparagraph below is required by some Federal agencies.
 - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

- A. Extra materials may not be allowed for publicly funded projects.
- B. 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. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
 - C. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. Cooper Industries, Inc.; Bussmann Div.
 - 3. Eagle Electric Mfg. Co., Inc.
 - 4. Ferraz Corp.
 - 5. General Electric Co.; Wiring Devices Div.
 - 6. Gould Shawmut.
 - 7. 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. Select and edit paragraphs below. Add paragraphs as Project requires to specify fuse applications rather than show them on Drawings.
 - B. Motor Branch Circuits: Class RK1, time delay.
 - C. 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 26 28 16.16

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and 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 other Sections 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. Eaton
- B. Square D Co.
- C. General Electric
- D. Siemens

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.
- D. 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.
- E. Current carrying parts shall be plated to resist corrosion.
- F. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
- G. 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.
- H. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
- I. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
- J. 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

- E. Install disconnect switches where indicated shown or not shown.
- F. Install fuses in fusible disconnect switches.

END OF SECTION

SECTION 26 32 13

STANDBY GENERATOR

PART 1- GENERAL

1.1 References and Standards

The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:

- CSA C22.2 No14
- CSA 282
- CSA 100
- EN61000-6
- EN55011
- FCC Part 15 Subpart B
- ISO8528
- IEC61000
- UL508
- UL2200
- UL142
- Designed to allow for installed compliance to NFPA 37, NFPA 70, NFPA 99 and NFPA 110

1.2 RELATED SECTIONS

1.3 WORK INCLUDED

A. Installation

The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories and automatic transfer switches specified under a separate section.

B. Fuel System

1. The CONTRACTOR shall provide a full tank of diesel fuel for the completion of all testing.

C. System Test

STANDBY GENERATOR

A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.

D. Requirements, Codes and Regulations

The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a MANUFACTURER who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.4 SUBSTITUTION

Proposed deviations from the specifications shall be treated as follows:

A. Substitution Time Requirement

Requests for substitutions shall be made a minimum of ten (10) days prior to bid date. Manufacturers catalog data shall accompany each request and authorized acceptance shall be addenda only.

B. Substitution Responsibility

The power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around GENERAC, KOHLER and CATERPILLAR for base bid. Should any substitutions be made, the CONTRACTOR shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions.

1.5 SUBMITTALS

Engine-generator submittals shall include the following information:

- A. Factory published specification sheet.
- B. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.
- C. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
- D. Weights of all equipment.
- E. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.

STANDBY GENERATOR

- F. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.
- G. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.
- H. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
- I. Generator resistances, reactances and time constants.
- J. Generator locked rotor motor starting curves.
- K. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.
- L. Manufacturer's and dealer's written warranty.

1.7 SYSTEM RESPONSIBILITY

A. Generator Set Distributor

The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only.

B. Requirements, Codes and Regulations

The equipment supplied and installed shall meet the requirements of NEC and all-applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

C. Automatic Transfer Switch

The automatic transfer switch(es) specified in another section shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

1.8 WARRANTY

A. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty

STANDBY GENERATOR

The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

1.9 PARTS AND SERVICE QUALIFICATIONS

A. Service Facility

The engine-generator supplier shall maintain 24-hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24hrs and 95% within 48 hours.

B. Service Personnel

The dealer shall maintain qualified factory trained service personnel.

PART 2- PRODUCT SPECIFICATIONS

2.1 GENERAL REQUIREMENTS

A. Generator set Requirements

The generator set shall be Standby Duty refer to drawings for KW rating, N/A RPM, 0.8 power factor, 208 V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 122F (50.0C) and altitude of 500.0 feet (152.4 m).

Standby Power Rating:

Power is available for the duration of an emergency outage

Average Power Output = 70% of standby power

Load = Varying

Typical Hours/Year = 200 Hours

Maximum Expected Usage = 500 hours/year

Typical Application = Standby

STANDBY GENERATOR

A. Material and Parts

- a. All materials and parts comprising the unit shall be new and unused.

B. Engine

- a. The engine shall be diesel fueled, four (4) cycle, turbocharged, charge air cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified kW / bHP rating. Emissions requirements / certifications of this package:
 - 1. EPA T3

C. Engine Governing

- a. The engine will be equipped with an isochronous electronic governor to maintain +/- 6 RPM steady state frequency variation from steady state no load to steady state full load.

2.2 GENERATOR

A. Generator Specifications

The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall be of brushless construction.

B. Voltage Regulator

STANDBY GENERATOR

C. Automatic Voltage Regulator

The automatic voltage regulator (AVR) shall maintain generator output voltage within $\pm 0.5\%$ for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, over-excitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed.

D. Integrated Voltage Regulator (IVR)

The IVR shall maintain generator output voltage within $\pm 0.25\%$ for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The IVR shall be capable of configuring knee frequency and voltage regulation configurable up to $\pm 30\%$. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The IVR shall be capable of setpoint adjustment.

E. Motor Starting

Provide locked rotor motor starting capability of 450sKW at 20% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

2.3 CIRCUIT BREAKER

A. Circuit Breaker Specifications

Provide a generator mounted 100% solid state circuit breaker, molded case, refer to drawings for size of breakers., 3 pole, NEMA 1/IP22. Breaker shall utilize a solid state trip unit. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.4 CONTROLS – GENERATOR SET MOUNTED (EMCP 4.2)

Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

A. Environmental

The generator set control shall be tested and certified to the following environmental conditions:

- A. -40°C to +70°C Operating Range
- B. 100% condensing humidity, 30°C to 60°C
- C. IP22 protection for rear of controller; IP55 when installed in control panel
- D. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
- E. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
- F. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
- G. Shock: withstand 15G

B. Functional Requirements

The following functionality shall be integral to the control panel.

- A. The control shall include a minimum 33 x 132 pixel, 24mm x 95mm, positive image, transfective LCD display with text based alarm/event descriptions.
- B. The control shall include a minimum of 3-line data display
- C. Audible horn for alarm and shutdown with horn silence switch
- D. Standard ISO labeling
- E. Multiple language capability
- F. Remote start/stop control
- G. Local run/off/auto control integral to system microprocessor
- H. Cooldown timer
- I. Speed adjust
- J. Lamp test
- K. Emergency stop push button
- L. Voltage adjust
- M. Voltage regulator V/Hz slope - adjustable
- N. Password protected system programming

C. Digital Monitoring Capability

STANDBY GENERATOR

The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

1. Engine

- A. Engine oil pressure
- B. Engine oil temperature
- C. Engine coolant temperature
- D. Engine RPM
- E. Battery volts
- F. Engine hours
- G. Engine crank attempt counter
- H. Engine successful start counter
- I. Service maintenance interval
- J. Real time clock
- K. Engine exhaust stack temperature
- L. Engine main bearing temperature

2. Generator

- A. Generator AC volts (Line to Line, Line to Neutral and Average)
- B. Generator AC current (Avg and Per Phase)
- C. Generator AC Frequency
- D. Generator kW (Total and Per Phase)
- E. Generator kVA (Total and Per Phase)
- F. Generator kVAR (Total and Per Phase)
- G. Power Factor (Avg and Per Phase)
- H. Total kW-hr
- I. Total kVAR-hr
- J. % kW
- K. % kVA
- L. % kVAR
- M. Generator bearing temperature
- N. Generator stator winding temperature

3. Voltage Regulation

- A. Excitation voltage
- B. Excitation current

D. Alarms and Shutdowns

The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

1. Engine Alarm/Shutdown

- A. Low oil pressure alarm/shutdown
- B. High coolant temperature alarm/shutdown
- C. Loss of coolant shutdown
- D. Overspeed shutdown
- E. Overcrank shutdown
- F. Emergency stop shutdown
- G. Low coolant temperature alarm
- H. Low battery voltage alarm
- I. High battery voltage alarm
- J. Control switch not in auto position alarm
- K. Battery charger failure alarm

2. Generator Alarm/Shutdown

- A. Generator phase sequence
- B. Generator over voltage
- C. Generator under voltage
- D. Generator over frequency
- E. Generator under frequency
- F. Generator reverse power (real and reactive)
- G. Generator overcurrent

3. Voltage Regulator Alarm/Shutdown

- A. Loss of excitation alarm/shutdown
- B. Instantaneous over excitation alarm/shutdown
- C. Time over excitation alarm/shutdown
- D. Rotating diode failure
- E. Loss of sensing
- F. Loss of PMG

E. Inputs and Outputs

1. Programmable Digital Inputs

The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

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2. Programmable Relay Outputs

The control shall include the ability to operate programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.

3. Programmable Discrete Outputs

The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.

F. Maintenance

All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control

- A. Engine running hours display
- B. Service maintenance interval (running hours or calendar days)
- C. Engine crank attempt counter
- D. Engine successful starts counter
- E. 40 events are stored in control panel memory
- F. Programmable cycle timer that starts and runs the generator for a predetermined time.
 - The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
 - 1. Day of week
 - 2. Time of day to start
 - 3. Duration of cycle

G. Remote Communications

1. Remote Communications

The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

2. Remote Monitoring Software

The control shall provide Monitoring Software with the following functionality

- A. Monitor up to eight (8) generator sets, plus ATS and UPS.
- B. Provide access to all data and events on generator set communications network

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- C. Provide remote control capability for the generator set(s)
- D. Ability to communicate via Modbus RTU or remote modem
- E. Ability to communicate email/text alerts.

H. Annunciation

1. Remote Annunciator (NFPA 99/110, CSA 282)

Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.

- A. The annunciator shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
- B. Ability to be located up to 4000 ft from the generator set
- C. The annunciator shall provide remote annunciation of all points listed below:
 - 1. Overcrank
 - 2. Low coolant temperature
 - 3. High coolant temperature warning
 - 4. High coolant temperature shutdown
 - 5. Low oil pressure warning
 - 6. Low oil pressure shutdown
 - 7. Overspeed
 - 8. Low coolant level
 - 9. EPS supplying load
 - 10. Control switch not in auto
 - 11. High battery voltage
 - 12. Low battery voltage
 - 13. Battery charger AC failure
 - 14. Emergency stop
 - 15. Spare
 - 16. Spare

2.5 COOLING SYSTEM

The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110 F* ambient air entering the room or enclosure (If an enclosure is specified). The generator set

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supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.6 FUEL SYSTEM

A. Fuel System

The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi. Include fuel 3/4 full.

B. Fuel Sub Base Tank

Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of 24 hour capacity shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

2.8 STARTING SYSTEM

A. Starting Motor

A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater

Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries

Batteries - A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system.

D. Battery Charger

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A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float and equalize charge settings, with provisions to automatically switch between the two modes. It shall maintain its rated output voltage within $\pm 0.2\%$ with AC input variation of $\pm 10\%$. Operational monitors shall provide with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of battery charger malfunction, low battery voltage, and high battery voltage. Charger shall include an Analog DC voltmeter and ammeter and fused AC input and DC output, and shall be wall mount type in a NEMA 1 enclosure.

2.9 ENCLOSURE

A. Attenuated Enclosure (Standard Sound optional)

The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.

A. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of ___ dba @ ___ ft with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.

B. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

PART 3- EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.2 START-UP AND TESTING

Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

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Perform a 4 hour load bank test at a 1.0 PF at full nameplate rating. Loadbank, cables and other equipment required for this test to be supplied by the genset supplier.

3.3 OPERATION AND MAINTENANCE MANUALS

Provide two (2) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.4 TRAINING

A. On-Site Training

Provide on-site training to instruct the owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

END OF SECTION

SECTION 26 36 00

ENCLOSED AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches
 - 2. Remote annunciation systems
- B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
 - 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
 - 2. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
 - 2. Internal electrical wiring and control drawings.

3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
 4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.
- C. Manufacturer and Supplier Qualification Data
1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
 2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
- E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

- A. Only approved bidders shall supply equipment provided under this contract.
- B. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
 2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
 3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- C. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.
- E. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
 - 1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
 - 2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
 - 3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
 - 4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
 - 5. IBC 2006 – The transfer switch(es) shall be prototype-tested and third-party certified to comply with the requirements of IBC group III or IV, Category D/F. The equipment shall be shipped with the installation instructions necessary to attain installation compliance
 - 6. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - 7. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
 - 8. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
 - 9. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
 - 10. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
 - 11. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
 - 12. IEC 1000-4-6 Conducted Field Immunity
 - 13. IEC 1000-4-11 Voltage Dip Immunity
 - 14. IEEE 62.41, AC Voltage Surge Immunity
 - 15. IEEE 62.45, AC Voltage Surge Testing
- F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.
- G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of one (1) year from registered commissioning and start-up, or eighteen (18) months from date of shipment.
- H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify (Architect/Construction Manager/Owner) no fewer than (insert appropriate number) days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without (Architect/Construction Manager/Owner's) written permission.
3. Do not energize any new service or distribution equipment without notification and permission of the (Architect/Construction Manager/Owner).

1.6 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASCO
 2. GE / Zenith
 3. Eaton
- B. Switches manufactured by Zenith, Eaton, or ASCO that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings. 600 OTPC, BY-PASS, level 1 controls, Nema 3R enclosure. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- B. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.
- C. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).

- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
 2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
 3. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
 5. The transfer switch operation shall include the ability to switch to an open position (both sources disconnected) for the purpose of load shedding from the generator set.
 6. The power transfer mechanism shall include provisions for manual operation under load with the enclosure door closed. Manual operation may be electromechanical or mechanical, but must be coordinated with control function.
 7. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
 8. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
 - a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
 9. Transfer switches designated on the drawings as “4-pole” shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles..
- G. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.
- H. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism
- I. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Terminal arrangement and cabinet space must be such that feeder conductors can enter from the top, side or bottom of the switch, at the installer’s discretion. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- J. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.

2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.
 - a. Transfer switches mounted in a controlled indoor environment shall be provided in NEMA Type 1 enclosures (IEC type IP30).

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:
 1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
 2. Main contacts shall be rated for 600 VAC minimum.
 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project..
- D. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.
- E. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
- F. The transfer switch physically located closest to the generator and not more than 50 ft (15 meters) away, except those served by generator paralleling equipment, shall be provided with a battery charger suitable for the requirements of the application and in compliance with NFPA 110 requirements for Level 1 systems. If no transfer switch is located within this distance, a battery charger shall be installed on the generator set.
- G. Automatic Transfer Switch Control Features
 1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
 3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device for load shedding purposes. On receipt of this signal, the transfer switch shall switch to a neutral position when connected to Source 2. If Source 1 is available when the load-shed signal is received, the transfer switch shall connect to Source 1.
 4. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
 5. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.
 6. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 7. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 8. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.
- H. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
1. The indicator panel LEDs shall display:
 - a. Which source the load is connected to (Source 1 or Source 2)
 - b. Which source or sources are available
 - c. When switch is not set for automatic operation, because the control is disabled or the bypass switch is in use
 - d. When the switch is in test/exercise mode
 2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
 - a. Activate pre-programmed test sequence
 - b. Override programmed delays, and immediately go to the next operation
 - c. Reset the control by clearing any faults
 - d. Test all of the LEDs by lighting them simultaneously

3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
 - a. AC voltage for all phases, normal and emergency
 - b. Source status: connected or not connected.
 - c. Load data, including voltage, AC current, frequency, KW, KVA, and power factor.
 4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
 - a. Set nominal voltage and frequency for the transfer switch
 - b. Adjust voltage and frequency sensor operation set points
 - c. Set up time clock functions
 - d. Set up load sequence functions
 - e. Enable or disable control functions including program transition
 - f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history
- I. Control Functions: Functions managed by the control shall include:
1. Software adjustable time delays:
 - a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
 - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
 - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
 - d. Engine cooldown: 0 to 30 minutes (default 10 min)
 - e. Programmed transition: 0 to 60 seconds (default 3 sec)
 2. Undervoltage sensing: three-phase normal, three-phase emergency source.
 - a. Pickup: 85 to 98% of nominal voltage (default 90%)
 - b. Dropout: 75 to 98% of nominal voltage (default 90%)
 - c. Dropout time delay: 0.1 to 1.0 seconds (default 0.5 sec)
 - d. Accurate to within +/- 1% of nominal voltage
 3. Over-voltage sensing: three-phase normal, three-phase emergency source.
 - a. Pickup: 95 to 99% of dropout setting (default 95%)
 - b. Dropout: 105 to 135% of nominal voltage (default 110%)
 - c. Dropout time delay: 0.5 to 120 seconds (default 3 sec)
 - d. Accurate to within +/- 1% of nominal voltage
 4. Over/under frequency sensing:
 - a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)

- b. Dropout: +/-1% beyond pickup (default 1%)
 - c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
 - d. Accurate to within +/- 0.2%
- 5. Voltage imbalance sensing:
 - a. Dropout: 2 to 10% (default 4%)
 - b. Pickup: 90% of dropout
 - c. Time delay: 2.0 to 20 seconds (default 5 sec)
- 6. Phase rotation sensing:
 - a. Time delay: 100 msec
- 7. Loss of single-phase detection:
 - a. Time delay: 100 msec
- J. Control features shall include:
 - 1. Programmable genset exerciser: A field-programmable control shall periodically start the generator, transfer the load to generator for a preset time, then re-transfer and shut down the generator after a preset cool-down period.
 - a. Push-button programming control shall have a selection of eight different schedules for exercising generator, with or without load.
 - 2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
 - 3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
 - 4. Transfer Override Switch: Overrides automatic re-transfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light to indicate override status.
- K. Control Interface
 - 1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
 - 2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.
 - 3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.
- L. Engine Starting Contacts

1. One isolated and normally closed, and one isolated and normally open; rated 10A at 32 VDC minimum.

2.4 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
 1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.
 3. Switch in test mode.
 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 1. Indicating Lights: Grouped for each transfer switch monitored.
 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
 4. Lamp Test: Push-to-test or lamp-test switch on front panel.
- C. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.
- D. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:

- a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

- B. Manufacturer's representative shall perform tests and inspections and prepare test reports.
- C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
 - 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
 - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify that the transfer switch is accurately metering AC voltage and current (when provided).
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 3. Ground-Fault Tests (if integral to transfer switch): Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
 - 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.

2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.6 SERVICE AND SUPPORT

- A. The manufacturer shall supply the Owner with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:
 1. The software shall be 32 bit and shall be XP and Vista compatible.
 2. The software shall use the Windows Explorer format, for ease of use and commonality with other software in use at the facility.
 3. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.
 4. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical "strip chart" displays.
 5. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.
 6. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 Electrical Sections, as applicable. Refer to other Sections 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.
- D. 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.
- E. 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)

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

- 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.
- E. 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.
- F.

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.
- 7 Electrical Requirements
- 8 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.
- 9 Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.

10 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.

11 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

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.

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

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

3.1 MANUFACTURER

- 1 Square D
- 2 Cutler-Hammer

3 Current Technology
4 THOR SYSTEMS

3.2 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

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions 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. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. Emergency lighting unit battery and charger.
 - 5. LED lights
 - 6. Retain two subparagraphs below for projects with air-handling fixtures.
 - 7. Types of lamps.
- B. Delete paragraph and subparagraph below unless custom fixtures are indicated.
- C. 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.
- D. Consider retaining paragraph below for projects with congested ceiling space and where Drawings do not include comprehensive reflected ceiling plans.
- E. 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.
- F. Retain paragraph and subparagraphs below if fixture Samples are required for verification purposes. Edit if sample requirements are indicated in other than interior lighting fixture schedule. As an alternative, list of fixture types for sample submission can be added below.
- G. Delete paragraph below if not required.
- H. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- I. Delete paragraph below except for projects with extensive tests of emergency lighting equipment.
- J. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

- K. Maintenance Data: For lighting fixtures to include in maintenance manuals in the close out documents.

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. Delete paragraph below if FM compliance is not required. Coordinate with Drawings.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Retain this Article if Coordination Drawings are not required.
- B. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

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.

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. NFPA 70 requires minimum support for fixtures. Retain paragraphs below for more specific support requirements and for requirements exceeding code minimums. Units in seismic zones must have additional supports and restraining devices beyond those specified here. See Editing Instruction No. 3 in the Evaluations.
- C. 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.

D. 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 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires and lamps.
- B. Related Sections include the following:
 - 1. Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires.
 - 2. Delete "independent" in subparagraph below if certified tests by manufacturer are adequate.
 - 3. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 4. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 - 5. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 6. High-intensity-discharge luminaire ballasts.
- B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.
- C. Delete paragraph below except for projects with extensive tests of installations.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For lighting units to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. General Warranty: LED fixture warranty is a five year limited warranty. Pole standard warranty is one year.

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 Exterior Lighting Unit Schedule at the end of Part 3.
- B. Retain above for nonproprietary or below for semiproprietary Specification, and name products in schedules or details.
- C. 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 LUMINAIRES

- A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. 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. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. 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.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:
 - 1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
 - 2. Relay Mounting: In luminaire housing.
- K. 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

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 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.
- B. Ground metal poles/support structures according to Section "Grounding and Bonding."
 1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:

3.3 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.

END OF SECTION

SECTION 27 05 33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

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 Sections 26 00 00, as applicable. Refer to other Sections 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.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Architectural sections.

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 inch, REFER TO PLANS FOR SIZES.
 - 2 Raceway installation shall be in accordance with Section 26 05 33.
 - 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.
 - 6 Provide a one-gang outlet unless noted otherwise.
 - 7 Install outlet box and device ring at each location.
 - 8 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.
 - 9 Install a blank cover plate on all unused communications outlet boxes.

END OF SECTION

SECTION 28 31 00

INTRUSION DETECTION

PART 1 - GENERAL

1.1 Manufacturer

- A. The manufacturer shall have at least twenty-five (25) 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 (20) 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 and 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. Intrusion detection/Access control pane(SEC) equipment manufacturer shall be EQUAL TO Digital Monitoring Products, Incorporated (DMP) #XR500N

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 Command Processor™ 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.
- D. 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.

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.

PART2 - SCOPE

2.1 Requirements

- A. Furnish and install a complete Intrusion Detection/ Access Control system (SEC) 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 Command Processor 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

- A. The system shall be listed as a Power Limited Device and be listed under the standards in the table. 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

Fire Listings

- UL 864 Control Units for Fire Protective Signaling Systems
- UL 985 Household Fire Warning

Access Control Listings

- UL 294 Access Control System Units

Related Listings

- NFPA 70 National Electric Code (NEC)
- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling
- NFPA 72 Household Fire Warning

U.S. Government Standards/Listings

- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

2.3 Americans with Disabilities

All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

PART 3 - SUBMITTALS

3.1 General Requirements

The contractor shall submit three (10) 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.

PART 4 - 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 tamper UL listed for use with the XR500/XR500N/XR500E 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 LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the 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.

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 Modes

- 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, 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 Serial Interface

The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.

4.8 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.
 - UL Listed DMP 504-24: 24 VDC 4 amps with transformer and enclosure.

4.9 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
- 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)
 - Rich Text (*.rtf)
 - Windows Metafile (*.wmf)
 - QuickReport (*.qrp)
 - Text (*.txt)
 - Comma-separated (*.csv)
 - HTML document (*.htm)
- E. The system shall interface with computer software capable of printing custom, filtered reports including:
- All Events
 - Zone Action
 - Arming/Disarming
 - Area Late to Close
 - User Code Changes
 - Door Access Granted
 - Door Access Denied
 - Opening/Closing
 - Schedule Changes
 - System Monitors
 - System Events

4.10 Control Panel Capability

The basic control panel shall provide:

- Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
- Sixteen (16) independent door/keypad addresses, each with four zones.
- Twenty (20) Holiday Dates for custom holiday scheduling by area.
- A total door access granted event buffer of at least 10,000 events.
- Anti-passback access control selectable by area and user.
- Four (4) shift schedules per area.
- A total of at least 100 programmable output relay schedules.
- Thirty-two (32) individual reporting areas.
- Built-in bell and telephone line supervision.

The networked control panel shall provide:

- All of the above features.
- Require two-man access code or credentials.
- 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.
- Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.

The encrypted control panel shall provide:

- All of the basic and network features listed above.
- Built-in Encrypted Alarm Router.
- Certified operation that meets 128 Bit AES Rijndael Encryption communications.

- Certified operation that meets SCIF (Sensitive Compartmented Information Facility) application needs.
- Certified operation that meets NIST (National Institute of Standards and Technology) standards.
- Certification that encrypted panel is capable of meeting DCID 6/9 standards.
- Certification that encrypted panel is capable of meeting UL 2050 standards.

PART 5 - 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, 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 200 wireless zones and/ or a maximum of 574 hardwired zones.
- F. The system shall be capable of offering at least 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 a minimum of 500 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.
- 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 502 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 502 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).
- C. The panel shall also provide 100 programmable output 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.

5.3 User/Authorization Level Capacity

- D. 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 keypads shall be DMP # 7063. The system shall support a maximum of sixteen (16) keypads with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code and 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.
- H. The system shall support sub-control keypads with four (4) built-in zones and capable of functioning in the following modes:
 - Panel monitors all four (4) keypad zones independently with a maximum of 125 keypads attached to the control panel
 - Panel assigns one (1) zone to each keypad and monitors all keypad zones as a single zone with a maximum of 500 keypads attached to the control panel
 - Stand-alone mode allowing keypad to operate as a self-contained security system independent of the control panel

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. It shall also have the capacity of a maximum of 125 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. The system shall have the capability to incorporate up to 200 zone expander POPIT™ points.
- E. Each zone shall function in any of the following configurations:

5.6 Communication

- A. The system shall be capable of signaling to two 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 process 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.
- B. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least two other standard industry formats.
- C. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet or token ring data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

• Night	• Supervisory	• Auxiliary 1	• Cross-
• Day	• Emergency	• Auxiliary 2	Zone
• Exit	• Panic	• Fire	• Priority
• Fire		Verification	Arming

5.7 Network Communication

- A. The control panel shall be capable of asynchronous network communication with a retry time between 3 and 15 seconds for a total of one (1) minute. 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. Network communication between the control panel and the receiver shall be in a proprietary communication format.
- C. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
- D. Underwriters Laboratories (UL) shall list network communication by the control panel for Grade AA High-Line Security.
- E. The control panel shall be capable of two-way network communication using standard Ethernet 10BaseT in a LAN, WAN, or Internet configuration.

- F. The control panel shall be capable of communication by means of a 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router.
- G. The control panel shall be capable of meeting DCID 6/9 and UL 2050 standards.

5.8 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 iCOM or iCOM-E installed in an SCS-1R receiver.
- B. The receiver iCOM or iCOM-E shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver iCOM or iCOM-E 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 iCOM or iCOM-E 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 iCOM or iCOM-E in Remote Link using the Trap Query function.

5.9 NAC Circuit Configuration

- A. The system shall be capable of additional Class B NAC circuits utilizing the Model 867 Notification Module. Each module shall be controlled and supervised via the SLC loop and monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions.
- B. The system shall be capable of providing Class A NAC circuits utilizing the Model 865 Notification Module. Each module shall monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions and have a manual bell silence switch.

PART6- 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 Early Morning Ambush (XR500N and XR500E 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.

6.5 Two-Man Rule (XR500N and XR500E 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.

6.6 UL Bank Safe & Vault Operation (XR500N and XR500E only)

The system shall be capable of being programmed to only be disarmed during scheduled times regardless of the authority level of any user code or user profile in the system. The schedule and time and date set for this area shall not be capable of being changed while the area is armed. Zones assigned to Bank Safe & Vault areas shall not be able to be bypassed or force armed.

6.7 Panic Button Summary Test (XR500N and XR500E only)

- 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.

PART7- 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.

PART8- PRODUCTS (NOT USED)

PART9- 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.

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

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

F. Additional Listings

- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling

A. U.S. Government Standards

- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

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.

PART10- Not used

PART11- COMPILED DETECTION EQUIPMENT LISTING

11.1 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:

- Motion Detector – equal to #C&K 907(hallways) and #C&K 706(classrooms)
- Door Contact – DMP Model SD70 (concealed applications – requires DMP zone expander)
- Bus Splitter/Repeater Module – DMP Model 710
- Door Contact – DMP Model SM20WG (surface applications – requires DMP zone expander)
- Output Expansion Module - DMP Models 710, 716
- Graphic Annunciator Module - DMP Model 717

11.3 Power Supplies and Transformers

Power supply, transformer, and battery devices 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 504-24LX, 115 VAC, 24 VDC
- Power Supply – DMP Model 505-12, 115 VAC, 12 VDC
- Power Supply – DMP Model 505-12LX, 115 VAC, 12 VDC
- Power Supply – DMP Model 508, 115 VAC, 12 or 24 VDC
- Transformer - DMP Model 326, 16 VAC 50 VA, Wire-in
- Transformer - DMP Model 327, 16.5 VAC 50 VA, Plug-in
- Transformer - DMP Model 322, 16.5 VAC 56 VA, Wire-in

PART12- INSTALLATION

12.1 System Component Installation

- When used in NFPA 72 compliant installations, the Intrusion Detection/ Access Control shall be on an electrical circuit dedicated branch in accordance with the National Electrical Code (NEC) and the local authority having jurisdiction (AHJ). This circuit shall be available only to authorized personnel and shall be clearly labeled "Security Alarm CIRCUIT CONTROL".
- 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).
- All wiring from all devices shall be non-spliced home runs.
- All cables shall be plenum rated.
- All conductors from expanders shall be home runs to control panel separately and shall be non spliced.
- All conductors terminating at zone splice box shall be identified as per detail device labeling.
- All zone splice boxes shall be located per owner's preference.
- All 120vac shall be provided by contractor to all power supply and panel locations shown or not shown on plans.
- Install siren in each inside hallway and one outdoor (weather proof).

J. Zone expanders and power supplies shall be installed in each electrical room.

END OF SECTION

SECTION 28 46 21.11

ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification Sections apply to Work covered by this Section.
- B. Comply with applicable sections in division 26. Refer to other Sections 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 additional and new devices for new building.
 - 1. Fire alarm control panel
 - 2. Remote Annunciator
 - 3. Addressable or conventional manual fire alarm stations.
 - 4. Addressable analog and conventional area smoke detectors.
 - 5. Conventional beam detectors.
 - 6. Addressable analog and conventional duct smoke detectors.
 - 7. Addressable analog and conventional heat detectors.
 - 8. Sprinkler water flow alarm switches.
 - 9. Audible notification appliances; bells, horns, chimes.
 - 10. Visual notification appliances; strobes.
 - 11. Central station alarm connection control.
 - 12. Air handling systems shutdown control.
 - 13. Magnetic door holder release.
 - 14. Dry pipe sprinkler release valve/deluge valve control.
 - 15. Sprinkler supervisory switches and tamper switch supervision.
 - 16. Dry pipe sprinkler release valve/deluge valve supervision.
 - 17. Battery standby.
 - 18. System shall activate the overhead gates. Provide all accessories for an active system.

1.3 SUBMITTALS

- A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 - PRODUCTS. Shop drawings shall be generated by the Fire Alarm Contractor without the Engineers plans.
- B. The submittal data shall include, but not necessarily be limited to, the following:
 - 1. Complete bill of material indicating quantity, part numbers and brief description.
 - 2. Data sheets for all products. If multiple models are shown on the same data sheet, highlight the specific model used.
 - 3. Provide drawing with all devices.

1.4 REFERENCE STANDARDS

- A. The fire alarm system devices specified herein shall be designed, manufactured, installed and tested according to the latest version of the following standards:

1 National Fire Protection Association Standards

- 1. NFPA 70 - National Electric Code (NEC), Articles 725 & 760.
- 2. NFPA 71 - Central Station Signaling Systems
- 3. NFPA 72 - National Fire Alarm Code (NFAC)
- 4. NFPA 92A - Smoke Control Systems
- 5. NFPA 101 - Life Safety Code

6. Underwriters Laboratories, Inc.
7. UL 38 - Manually Activated Signaling Boxes
8. UL 228 - Door Holders for Fire Protective Signaling Systems
9. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
10. UL268A - Smoke Detectors for Duct Applications
11. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems
12. UL 464 - Audible Signaling Appliances
13. UL 864/UOJZ/APOU - Control Units for Fire Protective Signaling Systems
14. UL 1481 - Power Supplies for Fire Protective Signaling Systems
15. UL 1638 - Visual Signaling Appliances
16. UL 1711 - Amplifiers for Fire Protective Signaling Systems
17. UL 1971 - Standard for Fire Protective Signaling Systems
18. Americans with Disabilities Act (ADA)
19. Local and State Building Codes
20. Local Authorities Having Jurisdiction (LAHJ)

1.5 QUALITY ASSURANCE

- A. The fire alarm system devices shall be listed and labeled by Underwriters Laboratories, Inc. for use in fire protective signaling system.
- B. The Installing Contractor shall be factory authorized and trained and shall be NICET certified in the sub-field of Fire Alarm Systems, for the engineering and technical installation and supervision of the system. This certification shall be Level III for engineering and Level II for technical installation and supervision. Proof of certification shall be provided. All work shall be performed by skilled technicians, under the supervision and direction of the designated NICET engineering technician, all of whom shall be properly trained and qualified for the work.
- C. The fire alarm contractor shall not sub out portion of the work. The fire alarm shall be responsible to complete the job.
- D. Submission to Authority Having Jurisdiction: Submit copies of State Certificate as required by State Fire Marshall. Provide copy with operating and maintenance manual.

1.6 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 the Rio Grande Valley 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.

1.7 WARRANTY

1. Warranty of all control equipment, sensors, I/O modules and all other peripherals and of materials, installation and workmanship shall be for one (1) year from date of acceptance.
2. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of final acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Silent Knight

2.2 CIRCUITING GUIDELINES

- B. Each addressable analog loop shall be circuited as shown on the drawings but device loading in not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class A operation. When it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class A zone wiring. The audio system components shall be an integral part of the fire alarm system control panel.
- C. Audio Amplifiers
 - 1. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any digitized audio channels. The channel selection shall be directed by the system software. Multiple and different audio signals shall be able to be broadcast simultaneously from the same system network node.
 - 2. Each amplifier output shall include a dedicated, supervised speaker circuit which is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit for connection of visual (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.
 - 3. Standby audio amplifiers shall be provided that automatically sense the failure of a primary amplifier, and automatically program themselves to select and de-multiplex the same audio information channel of the failed primary amplifier, and fully replace the function of the failed amplifier.
 - 4. In the event of a total loss of audio data communications, all amplifiers will default to the local "EVAC" tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC signal on their connected speaker circuits.
 - 5. In the event of a loss of the fully digitized, multiplexed audio riser, the audio amplifiers shall automatically default to an internally generated alarm tone.
 - 6. Audio amplifiers shall automatically detect a short circuit condition on the connected speaker circuit wiring, and shall inhibit itself from driving into that short circuit condition.

2.3 DETECTORS

- D. General
 - 1. Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters.
 - 2. Detectors shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total loop response time for detectors shall be 0.5 seconds.
 - 3. Detectors shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. Both LEDs on steady shall indicate alarm-standalone mode status. Both LEDs shall be visible through a full 360 degree viewing angle.
 - 4. Detectors shall be capable of identifying diagnostic codes to be used for system maintenance. The diagnostic codes shall be stored at the detector.
 - 5. Detectors shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each detector shall be individually programmable to operate at various sensibility settings.

6. The detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient "environmental thresholds." The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both long term and short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be permanently stored at the detector.
7. The detector and loop controller shall provide increased reliability and inherent survivability through intelligent conventional operation. The device shall automatically change to stand alone, conventional device operation in the event of a loop controller polling communications failure. In the standalone detector mode, the detector shall continue to operate using sensitivity and environmental compensation information, stored in its microprocessor at the time of communications failure. The loop controller shall monitor the loop and activate a loop alarm if a detector reaches its alarm sensitivity threshold.
8. Detectors shall be capable of automatic electronic addressing and/or custom addressing. Devices using DIP or rotary switches for addressing, either in the base or on the detector shall not be acceptable.
9. Detectors shall be suitable for operation in the following environment:
 1. Temperature: 32°F to 120°F
 2. Humidity: 0-93% RH, non-condensing
 3. Elevation: Up to 6,000 ft.
10. Photoelectric Smoke Detectors
 - ii. Addressable intelligent photoelectric smoke detectors shall be provided as indicated on the Drawings. The detector shall use a light scattering type photo electric smoke sensor to sense changes in air samples from its surroundings. An integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall utilize digital filters to remove signal patterns that are not typical of fires. Each detector shall have twin red/green status LEDs. The red LED shall indicate alarm condition and green LED shall indicate normal.
 - iii. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature and humidity. The information shall be stored in the integral processor and transferred to the loop controller.
 - iv. Detector shall be programmable for different sensitivity during day and night periods.
 - v. The detector shall be suitable for direct insertion into air ducts up to 3 ft. high and 3 ft. wide with air velocities up to 5,000 ft/min.
 - vi. The detector shall be rated for ceiling installation at a minimum of 30 foot centers.
 - vii. The percent smoke obscuration per foot alarm setpoint for the detector shall be field selectable to various sensitive settings ranging from 1.0% to 3.5%.
- b. Detector Mounting Bases
 - i. Detector mounting bases shall be suitable for mounting on a standard 4" square electrical outlet box. The base shall contain no electronics, support all detector types and have the following minimum requirements:
 1. Removal of the respective detector shall not affect communications with other detectors.
 2. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
 3. Capable of supporting a remote LED indicator and test station. Provide remote LED indicators and test stations as indicated on the Drawings.

- c. Detector Mounting Plates
 - i. Provide detector mounting plate assemblies to facilitate mounting detectors for direct insertion into low velocity ductwork. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish.
- d. Duct Smoke Detectors
 - i. Air duct mounted smoke detectors shall be provided in the air supply stream of all central air handling equipment above 2000 cfm, i.e. Provide all necessary interface wiring for proper system operation.
 - ii. The duct smoke detector shall be UL listed per UL 268A specifically for use in air handling systems. The detector shall operate at velocities of 300-4000 ft./min. The detector housing shall be equipped with an integral mounting base. It shall be capable of local testing via magnetic switch or remote testing using a remote test station. The duct detector housing shall incorporate an airtight smoke chamber in compliance with UL 268A. The housing shall be capable of mounting to either rectangular or round ducts without adaptor brackets. An integral filter system shall be included to reduce dust and residue effects on detector housing, thereby reducing maintenance and servicing. Sampling tubes shall be easily installed after the housing is mounted to the duct by passing through the duct housing. The housing shall have a red enamel finish.
 - iii. For each duct smoke detector provide a remote LED indicator and test station to be mounted in a location indicated on the Drawings and approved by the local authority having jurisdiction.
 - iv. F. Beam Type Smoke Detectors
 - 1. Provide projected beam type smoke detectors. Then beam detectors shall be four wire 24 Vdc and powered from the control panel 4 wire smoke power source. This unit shall consist of a separate transmitter and receiver capable of being powered separately or together. This unit shall operate in either a short range of 30 to 100 ft. (9.14 to 30.4m) or a long range of 100 to 300 ft. (30.4 to 91.4m). The detector shall feature a bank of four alignment LEDs on both the receiver and transmitter that are used to ensure proper alignment without the use of special tools. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses. Ceiling or mount as shown on the plans. Testing shall be carried out using calibrated test filters. Provide an activated remote test station>.
- b) SYSTEM MODULES
 - a. Addressable intelligent modules shall support supervised Class A circuits. The modules shall be multi-function capable of field programming. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
 - i. Temperature: 32°F to 120°F (0°C to 49°C)
 - ii. Humidity: 0-93% RH, non-condensing
 - b. Single Input Module
 - i. Addressable intelligent single input modules shall be provided as required for the system configuration. The single input module shall provide one (1) supervised Class A input circuit. The module shall be suitable for mounting on 4" square electrical box. The single input module shall support the following input circuit types:
 - 1. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)
 - 2. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 - 3. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
 - 4. Normally-Open Active Latching (Supervisory, Tamper Switches)
 - c. Dual Input Module

1. Addressable intelligent dual input modules shall be provided as required for the system configuration. The dual input module shall provide two (2) supervised CLASS A input circuits. The module shall be suitable for mounting on a standard 4" square electrical box. The dual input module shall support the following input circuit types:
 2. Normally-Open Alarm Latching (Manual Stations, Smoke Detectors, etc.)
 3. Normally-Open Alarm Delayed Latching (Waterflow Switches)
 4. Normally-Open Active Non-Latching (Monitors, Fans, Dampers, Doors, etc.)
 5. Normally-Open Active Latching (Supervisory, Tamper Switches)
- d. Monitor Module
 1. Addressable intelligent monitor modules shall be provided as required for the system configuration. The monitor module shall support one (1) supervised Class A normally-open active non-latching monitor circuit. The monitor module shall be suitable for mounting on a standard 4" square electrical box.
- e. Waterflow/Tamper Module
 1. Addressable intelligent waterflow/tamper modules shall be provided as required for the system configuration. The waterflow/tamper module shall support two (2) supervised Class A input circuits. Channel A shall support a normally-open alarm delayed latching waterflow switch circuit. Channel B shall support a normally-open active latching tamper switch. The waterflow/tamper module shall be suitable for mounting on a standard 4" square electrical box.
- f. Single Input Signal Module
 1. Addressable intelligent single input signal modules shall be provided as required for the system configuration. The single input signal module shall provide one (1) supervised Class A output circuit capable of supporting the operation of an audible/ visual signal power selector and a telephone power selector with ring tone for fire fighter's telephone. The module shall be suitable for mounting on a standard 4" square electrical box.
- g. Dual Input Signal Module
 1. Addressable intelligent dual input signal modules shall be provided as required for the system configuration. The dual input signal module shall provide a means to selectively connect one of two (2) signaling circuits to one (1) supervised output circuit. The dual input signal modules shall be capable of supporting the operation of an audible/visual signal power selector. The module shall be suitable for mounting on a standard 4" square electrical box.
- h. Control Relay Module
 1. Addressable intelligent control relay modules shall be provided as required for the system configuration. The control relay module shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on a standard 4" square electrical box.
- i. Universal Class A Module
 1. Addressable intelligent class A modules shall be provided as required for the system configuration. The universal class A module shall be capable of numerous operations. The module shall be suitable for mounting on a standard 4" square electrical box. The universal class A module shall support the following circuit types:
 1. Two (2) supervised Class A Normally-Open Alarm Latching.
 2. Two (2) supervised Class A Normally-Open Alarm Delayed Latching.
 3. Two (2) supervised Class A Normally-Open Active Non-Latching.
 4. Two (2) supervised Class A Normally-Open Active Latching.
 5. One (1) form "C" dry relay contact rated at 2 amps @ 24 Vdc.

6. One (1) supervised Class A Normally-Open Alarm Latching.
7. One (1) supervised Class A Normally-Open Alarm Delayed Latching.
8. One (1) supervised Class A Normally-Open Active Non-Latching.
9. One (1) supervised Class A Normally-Open Active Latching.
10. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
11. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
12. One (1) supervised Class A 2-wire Smoke Alarm Verified
13. One (1) supervised Class A 2-wire Smoke Alarm Verified
14. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
15. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.

c) MANUAL PULL STATIONS

- a. Addressable intelligent dual action, non-break glass type, key reset, semi-flush mounted manual pull stations shall be provided as indicated on the Drawings. The stations shall be of Lexan construction, finished in red with white molded raised letters "PULL IN CASE OF FIRE". The station shall be suitable for mounting on a standard 4" square electrical box. The station shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing diagnostic codes which can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment:
 - i. Temperature: 32°F to 120°F (0°C to 49°C)
 - ii. Humidity: 0-93% RH, non-condensing

d) NOTIFICATION APPLIANCES

- a. General
 - i. All appliances shall be UL listed for Fire Protective Service. All audible appliances, visual appliances and combination audible/visual appliances shall be capable of providing the equivalent facilitation which is allowed under the Americans with Disabilities Act Accessibility Guidelines (ADA/AG), and shall be UL 1971, and ULC S526 listed.
- b. Audible Only Notification Appliances
 - i. Audible appliances shall be a mylar cone type speaker. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
 - ii. Audible appliances shall be provided with in/out wiring terminals.
 - iii. Audible appliances shall be flush for ceiling mounted and flush/semi-flush for wall mounted as indicated on the Drawings. They shall have a white faceplate for ceiling mounting and red faceplate for wall mounting. They shall mount to a standard 4" square electrical box.
- c. Visual Only Notification Appliances
 - i. Visual appliances shall be a self-synchronized strobe. The strobe flashtube shall be enclosed in a rugged lexan lens with solid state circuitry. The strobe shall provide 15, 15/75, 30, 60 and 110 candela synchronized flash outputs. The strobe intensity selection shall be based on the installed location within the building.
 - ii. Visual appliances shall be provided with in/out field wiring terminals.
 - iii. Visual appliances shall have lens markings oriented for wall mounting where indicated on the Drawings. They shall have a red faceplate for flush/semi-flush wall mounting. They shall mount to a standard 4" square electrical outlet box.
- d. Combination Audible/Visual Notification Appliances
 - i. Combination appliances shall be a combination of the audible and visual appliances specified

previously. They shall have a red faceplate for flush/semi-flush wall mounting.

- ii. The majority, if not all, of the notification appliances shall be combination devices such that the visual and audible requirements of ADA shall be complied with. Visual notification appliances shall be located in all areas of common use, i.e. lobbies, hallways, restrooms, meeting/conference/assembly areas, break rooms, copy/fax/mail rooms, etc. Audible notification appliances shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15dbA or exceeds any maximum sound level with a duration of 60 seconds by 5dbA, whichever is louder. Sound levels for alarm signals shall not exceed 120 dbA. It is the intent of the Drawings to show all devices that are required. The fire alarm system vendor/bidder shall provide all appliances shown and/or required by these specifications but it others are anticipated to be required the vendor/bidder shall qualify the provisions for the system making note of the additional cost for the anticipated additional requirements.

e) **ANCILLARY DEVICES**

a. **Remote Relays**

i. **Multi-Voltage Control Relays**

- 1. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT or DPDT, as required, and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 12 Vdc, 12 Vac, 24 Vdc, 24 Vac, 115 Vac, or 230 Vac, as required. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

ii. **Manual Override Control Relays**

- 1. Remote control relays with a manual override shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac or 24 Vdc. A single relay may be energized from a voltage source of 24 Vdc or 24 Vac. A red LED shall indicate the relay is energized.

iii. **Heavy Duty Power Relays**

- 1. Remote control relays shall be provided as required for the system configuration for connection to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 30 amperes at 300 Vac or 2 HP motor load. A single relay may be energized from a voltage source of 24 Vac, 115 Vac, as required. A metal enclosure shall be provided.

f) **ELECTROMAGNETIC DOOR HOLDERS**

- a. Provide single or double door, floor or wall mounted electromagnetic door holder/release devices as indicated on the Drawings. The devices shall be rated for 24V ac/dc input. The devices shall be brushed zinc finished.

g) **FIRE ALARM CABLE**

- a. 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).
- b. **Cable Construction**
 - i. Conductors shall be solid, soft annealed, uncoated copper.
 - ii. Insulation shall be 300 volt, 105°C polyvinylchloride.
 - iii. Two conductor, non-shielded cables shall be parallel; shielded and three or more conductors shall be cabled round.
 - iv. Shielding shall be mylar backed aluminum foil, helically wrapped to provide 100% coverage. A suitable copper drain wire shall be provided with shielded cables.

- v. Jacket shall be red, 105°C polyvinylchloride, rated 300 volt.
- vi. Cable shall be plenum rated when installed in air handling plenums.
- c. 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 - EXECUTION

3.1 APPROVALS

- A. Complete fire alarm system drawings shall be issued to the Local Authority Having Jurisdiction for approval prior to the installation of the fire alarm system.

3.2 INSTALLATION

- A. Installation of the Fire Alarm System shall be in strict compliance with manufacturers recommendations. The entire system shall be installed in accordance with approved manufacturers manuals and wiring diagrams and as approved by the Local Authority Having Jurisdiction.
- B. Fire alarm cable shall be installed in conduit in areas of exposed structure and within inaccessible ceilings. Conduit shall also be provided from outlet boxes within walls stubbed up to accessible ceilings. Provide end bushings on conduit stub-ups. Cable only is acceptable in accessible ceilings.
- C. All conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation shall be included as part of the system. All junction box blank coverplates shall be labeled with a red "F.A." for identification purposes.
- D. All wiring shall be color coded throughout.
- E. The system shall be installed and fully tested under the supervision of trained manufacturer's representatives. The system shall be demonstrated to perform all the functions as specified.

END OF SECTION