

PROJECT MANUAL
INCLUDING SPECIFICATIONS
FOR

TEXAS AGGIES CORPS OF CADETS ASSOCIATION

PROJECT NUMBER:
202503

ISSUED FOR
CONSTRUCTION



TEXAS AGGIE
CORPS *of* CADETS
ASSOCIATION

DATE: 06-04-2025

PREPARED BY:

SINGLETON ZIMMER ARCHITECTURE



TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 0101	PROJECT TITLE PAGE (REPLACE WITH CUSTOM TITLE PAGE)
00 6113	TEXAS STATUTORY PERFORMANCE BOND
00 6114	TEXAS STATUTORY PAYMENT BOND
00 6519	WAIVER AND RELEASE OF LIENS
00 6520	CONDITIONAL WAIVER FOR PROGRESS PAYMENTS FORM
00 6521	UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS FORM
00 6522	CONDITIONAL WAIVER FOR FINAL PAYMENTS FORM
00 6523	UNCONDITIONAL WAIVER FOR FINAL PAYMENTS FORM

DIVISION 01 - GENERAL REQUIREMENTS

01 1100	SUMMARY OF WORK
01 2100	ALLOWANCES
01 2513	PRODUCT SUBSTITUTION PROCEDURES
01 2516	SUBSTITUTION REQUEST FORM
01 2900	PAYMENT PROCEDURES
01 2973	SCHEDULE OF VALUES
01 3113	PROJECT COORDINATION
01 3119	PROJECT MEETINGS
01 3216	CONSTRUCTION PROGRESS SCHEDULE
01 3300	SUBMITTAL PROCEDURES
01 4500	QUALITY CONTROL
01 4523	TESTING AND INSPECTING SERVICES
01 4529	STRUCTURAL TESTING AND INSPECTIONS
01 5000	TEMPORARY FACILITIES AND CONTROLS
01 5500	VEHICULAR ACCESS AND PARKING
01 5713	TEMPORARY EROSION AND SEDIMENT CONTROL
01 6000	PRODUCT REQUIREMENTS
01 7000	EXECUTION AND CLOSEOUT REQUIREMENTS
01 7329	CUTTING AND PATCHING
01 7419	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 7700	CLOSEOUT PROCEDURES
01 7839	PROJECT RECORD DOCUMENTS
01 7900	DEMONSTRATION AND TRAINING

DIVISION 02 - EXISTING CONDITIONS

02 3200	GEOTECHNICAL INVESTIGATIONS
02 4116	DEMOLITION

DIVISION 03 - CONCRETE

03 0516	UNDERSLAB VAPOR BARRIER
---------	-------------------------



03 3000	CAST-IN-PLACE CONCRETE
03 3500	POLISHED CONCRETE FINISHING
DIVISION 04 - MASONRY	
04 2723	CAVITY WALL UNIT MASONRY
DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES	
06 1000	ROUGH CARPENTRY
06 2000	FINISH CARPENTRY AND MILLWORK
06 4100	ARCHITECTURAL WOOD CASEWORK
DIVISION 07 - THERMAL AND MOISTURE PROTECTION	
07 1400	FLUID-APPLIED WATERPROOFING
07 2100	THERMAL INSULATION
07 6200	SHEET METAL FLASHING AND TRIM
07 9200	JOINT SEALANTS
07 9500	EXPANSION CONTROL
DIVISION 08 - OPENINGS	
08 1113	HOLLOW METAL DOORS AND FRAMES
08 1423	PLASTIC LAMINATE FACED WOOD DOORS
08 4313	ALUMINUM-FRAMED STOREFRONTS
08 8000	GLAZED SYSTEMS
08 9100	PRE-FINISHED ALUMINUM LOUVERS
DIVISION 09 - FINISHES	
09 2116	GYPSUM WALLBOARD SYSTEMS
09 3019	PORCELAIN TILE
09 6513	RESILIENT BASE
09 6813	TILE CARPETING
09 9100	PAINTING AND STAINING
09 9113	EXTERIOR PAINTING
09 9123	INTERIOR PAINTING
DIVISION 10 - SPECIALTIES	
10 0100	MISCELLANEOUS SPECIALTIES
10 1400	GRAPHICS
10 2113.19	SOLID POLYMER TOILET PARTITIONS
10 2813	TOILET ROOM ACCESSORIES
10 4413	FIRE EXTINGUISHER AND CABINETS
10 7500	FLAGPOLES
DIVISION 31 - EARTHWORK	
31 3116	TERMITE CONTROL
DIVISION 32 - EXTERIOR IMPROVEMENTS	
32 1723	PAVEMENT MARKINGS

TABLE OF CONTENTS

Division 01 - General Requirements

01 9100 Building Systems Commissioning

Division 22 - Plumbing

22 0006 Plumbing Demolition
22 0100 Special Conditions for All Plumbing Work
22 0500 Basic Plumbing Materials and Methods
22 0519 Meters and Gages for Plumbing
22 0523 General-Duty Valves for Plumbing Piping
22 0529 Hangers and Supports for Plumbing Piping and Equipment
22 0553 Identification for Plumbing Piping and Equipment
22 0716 Plumbing Insulation
22 0800 Plumbing Systems Commissioning
22 1116 Domestic Water Piping
22 1119 Domestic Water Piping Specialties
22 1316 Sanitary Waste and Vent Piping
22 1319 Drain Piping Specialties
22 1940 Fuel Gas Piping
22 3400 Fuel-Fired, Domestic Water Heaters
22 4100 Plumbing Fixtures

Division 23 - Heating, Ventilation and Air Conditioning

23 0005 Mechanical Demolition
23 0100 Special Conditions for All Mechanical Work
23 0529 Hangers and Supports for HVAC Piping and Equipment
23 0553 Mechanical Identification
23 0593 Testing, Adjusting and Balancing
23 0719 Mechanical Insulation
23 3113 Metal Ducts
23 3300 Duct Accessories
23 3423 HVAC Power Ventilators
23 3713 Diffusers, Registers and Grilles
23 8126 Split System Air-Conditioning Units
23 8219 Fan Coil Units
23 8560 Intake and Relief Ventilators
23 8561 Air Filters

Division 26 - Electrical

26 0005 Electrical Demolition
26 0015 General Conditions for All Electrical Work
26 0050 Basic Electrical Materials and Methods
26 0519 Conductors and Cables
26 0526 Grounding and Bonding
26 0533 Raceways and Boxes
26 0553 Electrical Identification
26 0800 Electrical Systems Commissioning
26 0923 Lighting Control Devices
26 1310 Pull and Junction Boxes
26 2416 Panelboards
26 2726 Wiring Devices
26 2816 Disconnect Switches and Circuit Breakers
26 5100 Interior Lighting

END OF TABLE OF CONTENTS



SECTION 00 6113
TEXAS STATUTORY PERFORMANCE BOND

TEXAS STATUTORY PERFORMANCE BOND BOND NO:_____

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

KNOW ALL MEN BY THESE PRESENTS, that: _____

(hereinafter called the Principal), as principal, and _____,
A CORPORATION ORGANIZED AND EXISTING UNDER THE LAWS OF THE STATE OF
TEXAS authorized and admitted to do business in the State of Texas and licensed by the State
of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and
firmly bound unto:

(HEREINAFTER CALLED THE OBLIGEE) IN THE AMOUNT OF: _____

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

WHEREAS, the Principal has entered into a certain written contract with the Obligee,

dated the _____ day of _____, 20 _____

FOR

Texas Aggies Corps of Cadets Association
AT
Texas Aggies Corps of Cadets Association

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

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

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument

this _____ day of _____, 20 _____

(SEAL)

PRINCIPAL

(SEAL)

SURETY

(SEAL)

ATTORNEY-IN-FACT

SURETY ADDRESS

SURETY TELEPHONE NUMBER

END OF SECTION

**SECTION 00 6114
TEXAS STATUTORY PAYMENT BOND**

TEXAS STATUTORY PAYMENT BOND BOND NO:_____

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

KNOW ALL MEN BY THESE PRESENTS, that: _____

(hereinafter called the Principal), as principal, and _____,
A CORPORATION ORGANIZED AND EXISTING UNDER THE LAWS OF THE STATE OF TEXAS authorized and admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto:

(HEREINAFTER CALLED THE OBLIGEE) IN THE AMOUNT OF: _____

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

WHEREAS, the Principal has entered into a certain written contract with the Obligee,

dated the _____ day of _____, 20 _____

FOR

Texas Aggies Corps of Cadets Association
AT
Texas Aggies Corps of Cadets Association

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

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

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this bond to all such claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument

this _____ day of _____, 20 _____

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

(SEAL)

PRINCIPAL

(SEAL)

SURETY

(SEAL)

ATTORNEY-IN-FACT

SURETY ADDRESS

SURETY TELEPHONE NUMBER

END OF SECTION

**SECTION 00 6519
WAIVER AND RELEASE OF LIENS**

PART 1 GENERAL

1.01 SUMMARY

- A. Document Includes: Applicability and use of statutory Waiver and Release of Lien forms promulgated by the Legislature of the State of Texas for construction projects in Texas.

1.02 RELATED REQUIREMENTS:

- A. The Contract for Construction (also referred to as the Agreement or the Contract)
- B. Conditions of the Contract (General, Supplementary, and other conditions, if any)
- C. Section 01 2900 Payment Procedures
- D. Section 01 7700 Contract Closeout
- E. Section 01 7701 Closeout Procedures

1.03 REFERENCE STANDARDS

- A. Texas Property Code, Chapter 53, Subchapter L, Sections 53.281 thru 53.287 (includes the standard forms attached herewith immediately following this section):
- B. Form 1: Conditional Waiver for Progress Payments
- C. Form 2: Unconditional Waiver for Progress Payments
- D. Form 3: Conditional Waiver for Final Payments
- E. Form 4: Unconditional Waiver for Final Payments

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SELECTION AND USE OF WAIVER AND RELEASE OF LIEN FORMS

- A. Based on answers to the following questions, use the applicable form for the occasion:
 1. Is the payment a progress payment (partial, not final), or a final payment?
 2. Is the release unconditional (for a payment already received), or conditional (given in anticipation of a payment not yet received)?
- B. Submit the applicable form, properly executed (filled out, signed and dated) and notarized, on each occasion required (see other portions of the Contract Documents, including but not necessarily limited to the related requirements documents cited above).
- C. The wording of these forms is prescribed by the State of Texas. Questions regarding their use, execution, etc. should be directed to user's own attorney experienced in construction or lien law. This document is not to be interpreted as rendering legal advice.
- D. Even if the Contract Documents do not explicitly require submittal of Waivers and Releases of Liens for every payment (for example, omitting them for monthly progress payments), the Owner reserves the right, at its sole discretion, to require applicable Waivers and Releases of Liens, executed and notarized, for any or all payments.

END OF SECTION

**SECTION 00 6520
CONDITIONAL WAIVER FOR PROGRESS PAYMENTS FORM**

PROJECT NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
OWNER'S NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
PROJECT NUMBER: 202503

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

On receipt by the signer of this document of a check from _____ (maker of check)

in the sum of \$ _____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the

property of _____ (owner) located at _____ (location) to the following extent:

_____ (job description).

This release covers a progress payment for all labor, services, equipment, or materials

furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Printed Name: _____

Signature: _____

Title: _____

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

SUBSCRIBED AND SWORN TO ME ON THIS _____ DAY OF _____, 20____

NOTARY PUBLIC: _____ STATE OF _____

END OF SECTION

SECTION 00 6521
UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS FORM

PROJECT NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
OWNER'S NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
PROJECT NUMBER: 202503

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT
YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A
PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID
THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A
CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

The signer of this document has been paid and has received a progress payment in the sum of

\$ _____ for all labor, services, equipment, or materials furnished to the property or to

_____ (person with whom signer contracted) on the property of

_____ (Owner) located at _____ (location) to the
following extent:

_____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:

_____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Printed Name: _____

Signature: _____

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

Title: _____

SUBSCRIBED AND SWORN TO ME ON THIS _____ DAY OF _____, 20____

NOTARY PUBLIC: _____ STATE OF _____

END OF SECTION

SECTION 00 6522
CONDITIONAL WAIVER FOR FINAL PAYMENTS FORM

PROJECT NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
OWNER'S NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION
PROJECT NUMBER: 202503

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: _____

Job No: _____

On receipt by the signer of this document of a check from _____ (maker of check)

in the sum of \$ _____, payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the

property of _____ (owner) located at _____ (location) to the following extent:

_____ (job description).

This release covers a progress payment for all labor, services, equipment, or materials

furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

Printed Name: _____

Signature: _____

Title: _____

SUBSCRIBED AND SWORN TO ME ON THIS _____ DAY OF _____, 20____

NOTARY PUBLIC: _____ STATE OF _____

END OF SECTION

SECTION 00 6523
UNCONDITIONAL WAIVER FOR FINAL PAYMENTS FORM

PROJECT NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION

OWNER'S NAME: TEXAS AGGIES CORPS OF CADETS ASSOCIATION

PROJECT NUMBER: 202503

4.01

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT
YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A
PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID
THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A
CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

A.

Project: _____

Job No: _____

The signer of this document has been paid in full for all labor, services, equipment, or materials

furnished to the property or _____ (person with whom signer contracted)

on the property of _____ (owner) located at _____ (location)
to the following extent:

_____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____

Company Name: _____

Printed Name: _____

Signature: _____

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

Title: _____

SUBSCRIBED AND SWORN TO ME ON THIS _____ DAY OF _____, 20____

NOTARY PUBLIC: _____ STATE OF _____

4.02

END OF SECTION

SECTION 01 1100
SUMMARY OF WORK

PART 1 - GENERAL

1.01 PROJECT DESCRIPTION

- A. The Project, Texas Aggies Corps of Cadets Association , 1507 S College Ave for Texas Aggies Corps of Cadets Association .

1.02 SCOPE OF WORK

- A. The Work shall consist of New Construction and Renovations to existing facilities as described in the contract documents.
- B. Work shall include, but shall not be limited to the following:
 - 1. All exterior improvements, earthwork, utilities, structural, architectural, MEP and IT systems to provide a new Texas Aggies Corps of Cadets Association Headquarters and Boot Storage with offices and boot warehousing.

1.03 SALVAGED MATERIALS

- A. Owner may salvage all items deemed reusable or necessary to keep from facilities to be demolished prior to the start of demolition.
- B. Contractor shall remove and turn additional items over to the Owner, as directed.
- C. Contractor shall demolish, remove and salvage all other items of demolished work.

1.04 CONTRACTS AND USE OF SITE

- A. Contractor Use of Premises:
 - 1. Confine operations at site to areas permitted by:
 - a. Law
 - b. Ordinances
 - c. Permits
 - d. Contract Documents
 - 2. Do not unreasonably encumber site with materials or equipment.
 - 3. Assume full responsibility for protection and safekeeping of products stored on premises.
 - 4. Obtain and pay for use of additional storage or work areas as needed for operations.
 - 5. Contractor shall establish secured staging area for work and coordinate and provide for safe passage and exit from building areas during construction, as determined by City and District officials.
 - 6. Contractor shall coordinate all construction activities with Owner.
 - 7. Owner reserves the right to perform construction operations with its own forces or to employ separate contractors on portions of the Project. Contractor shall coordinate with this work in terms of providing site access, work space, and storage space, cooperation of work forces, scheduling, and technical requirements.
 - 8. Coordinate all utility shutdowns with Owner and, as required, with local utility companies, prior to commencement of shutdown.
- B. Owner-Furnished Items:
 - 1. The Owner may provide items to the Contractor for installation in accordance with manufacturer's recommendations and instructions.
 - 2. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule, and will inspect deliveries for damage.
 - 3. If Owner-furnished items are damaged, defective or missing, through no fault of the Contractor, the Owner will arrange for replacement.
 - 4. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving, unloading and handling Owner-furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to elements, and to repair or replace items damaged as a result of his operations.

- C. Coordination with Work by Owner and by Owner's Separate Contractors:
 - 1. The Owner reserves the right to perform other work for the Project, and to engage other separate contractors to perform other work for the Project. Provide site access, space allocation, scheduling, scheduling coordination, coordination of work forces and coordination of technical requirements with other contractors that may be selected and employed by Owner to perform other work simultaneously and in conjunction with the Work of This Contract.
- D. The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any resulting loss or damage but only to the extent the Owner would be responsible for any such losses or damages under state and/or federal law.
- E. The Architect will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract, except as noted in the above paragraph.
- F. No demolition will be allowed above, below, adjacent to or near any occupied areas of the existing building.

1.05 PROTECTION OF EXISTING PROPERTY

- A. Contractor shall provide and maintain adequate protection of all Owner's existing property during duration of Project.
- B. Contractor shall verify location of all existing underground pipelines on site with the owner of such pipelines and authorities having jurisdiction and shall provide and maintain adequate protection of all such pipelines during duration of Project.
- C. Protection of Trees:
 - 1. Provide barricades around trees and shrubs at their drip line in traffic areas to protect them from construction operations until Substantial Completion, or until barricade removal is directed by Architect.

1.06 USE OF ASBESTOS FREE MATERIALS, PRODUCTS AND SYSTEMS

- A. The Contractor is reminded to refer to 00 2116 Instructions to Proposers for requirements regarding asbestos containing materials (ACM).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Refer to Specification Sections.

PART 3 - EXECUTION

3.01 CONSTRUCTION SCHEDULE

- A. The Owner has a critical need for the work to begin upon Notice to Proceed and shall be Substantially Complete by 2026 .

B. Refer to Section 01 3216 for other scheduling requirements.

END OF SECTION

SECTION 01 2100 ALLOWANCES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Cash allowances are hereby established for Owner's Contingency, Scope of Work items and materials in the amounts listed below and shall be included in the Contract Sum. These sums shall be reconciled in accordance with Article 3.8 of the General Conditions.
 - 2. Allowances for materials, such as brick, tile, etc., shall be for the net cost of materials only, without sales tax, delivered and unloaded at the jobsite. The party who makes the purchase (Contractor or subcontractor) shall include handling costs on site, labor, overhead, profit and other expenses contemplated for each allowance in the Contractor's Sum and not in the allowance. Include labor under allowance, only when labor is specified to be included.
 - 3. Allowances for Scope of Work , such as Owner's contingency, graphics, technology, etc., will be adjusted, as necessary, to reflect the difference between the allowance amount stated and Contractor's handling costs, cost of materials, without sales tax, plus labor, subcontract costs, with overhead and profit markup, and any other reasonable costs, except the Contractor's overhead and profit, which is not allowed.
 - 4. Contractor shall cause the work covered by these allowances to be performed for such amounts and by such persons as the Architect may direct or by persons selected by competitive sealed proposals, but he will not be required to employ persons against whom he makes reasonable objection. If any items cost less than the amount listed, the Owner shall be given a credit in the amount of the difference. If the Owner so desires, credits in one allowance category may be transferred to any other allowance category. If any items cost more than the amount listed, such adjustment will include additional handling costs on the site, labor, installation costs, overhead, profit and other expenses resulting to the Contractor or subcontractor from any increase over the original allowance, unless such increase is funded by a transfer of funds from other allowances in which case no overhead and profit will be allowed. If the final cost of all allowances, when determined, is more or less than the sum of the allowances, the Contract Sum will be adjusted accordingly by Change Order.
 - 5. Contractor shall proceed with the work in question only after receiving written directions executed by the Owner and the Architect. Such direction will be provided by an Allowance Expenditure Authorization prepared by the Architect and executed by Owner, Architect and Contractor. Owner will not be obligated to pay the cost of any work completed without prior authorization.
 - 6. Unexpended balance of allowance sums shall revert to the Owner in the final settlement of the Contract.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.

1.02 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.03 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- D. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.04 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.05 LUMP-SUM UNIT-COST AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
- D. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.06 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.07 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.08 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
- B. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.02 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.03 SCHEDULE OF ALLOWANCES

3.04 ALLOWANCES

- A. Owner's Contingency Allowances: \$25,000.00
 1. Contractor shall include the amount indicated above in his Base Bid as a contingency to cover the cost of hidden, concealed or otherwise unforeseen conditions which develop during completion of the work. Contractor shall be allowed to recover all costs associated with the completion of work under this contingency, however, no overhead or profit will be allowed.
- B. Contractor's Contingency Allowances: \$25,000.00
 1. Contractor shall include the amount indicated above in his Base Bid as a contingency to cover the cost of hidden, concealed or otherwise unforeseen conditions which develop during completion of the work. Contractor shall be allowed to recover all costs associated with the completion of work under this contingency, however, no overhead or profit will be allowed.
- C. Testing Allowance: \$15,000.00
 1. Contractor shall include the amount indicated above in his Base Bid for the cost of providing all required testing and inspections for the project in accordance with Sections 01 4523 & 01 4529.
- D. Landscaping Allowance: \$25,000.00
 1. Contractor shall include the amount indicated above in his Base Bid for the cost of providing irrigation and planting to areas as indicated on drawings or by Owner, and for sodding and hydromulching of areas affected by construction.

END OF SECTION

SECTION 01 2513
PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Specified product compliance, and product quality assurance
- B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
- C. Requirements for product delivery, storage and handling.

1.02 RELATED REQUIREMENTS

- A. Instructions to Proposers: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.03 DESCRIPTION OF REQUIREMENTS

- A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
 - 1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material", "equipment", "system", and other terms of similar intent.
 - a. Named Products: Are those identified by the use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
 - b. Specified Products: same as Named Products.
 - 2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
 - 3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.04 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
 - 1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.
- B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. Or Equal:
 - 1. Where the phrase "or equal", "or equivalent", "or Architects approved equal", or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or

- methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
2. The decision of the Architect shall be final.
 - D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.
 - E. Foreign Product Limitations: "Foreign products" as distinguished from "domestic products" are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
 - a. There is no domestic product available that complies with the requirements of the Contract Documents.
 - b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
 - c. At the discretion of the Architect or Owner.
 2. Final determination and acceptance will be the responsibility of the Architect.
 - F. Standards: Refer to Section 01 4100, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.05 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of Proposals.
- B. No substitution will be considered prior to receipt of Proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of Proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves any proposed substitution prior to receipt of Proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. The following are not considered as substitutions:
 1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as "changes" not substitutions.
 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.

3. Except as otherwise provided in the Contract Documents, the Contractor's determination of and compliance with governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
 1. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:
 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposal. Submit Request for Substitutions in accordance with this section.
 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- H. A request constitutes a representation that Proposer:
 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- I. No substitutions will be considered after the Award of Contract.

1.06 SUBSTITUTION REQUEST SUBMITTAL

- A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete

documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:

1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
- B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.
 2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
 3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
 5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT COMPLIANCE

- A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may

be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:

1. Proprietary
 2. Descriptive
 3. Performance
 4. Compliance with Reference Standards
- B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process.
- C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
1. Proprietary and Semi-Proprietary Specification Requirements:
 - a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
 - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
 2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
 3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.
 4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
 5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
 6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.

7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
 8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.
- D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.02 SUBSTITUTIONS

- A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.01 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.
- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.
- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.02 INSTALLATION OF APPROVED SUBSTITUTIONS

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION

**SECTION 01 2516
SUBSTITUTION REQUEST FORM**

PROJECT: TEXAS AGGIES CORPS OF CADETS ASSOCIATION

PROJECT NO.

FROM: _____

BIDDER HEREBY REQUESTS ACCEPTANCE OF THE FOLLOWING PRODUCT OR SYSTEM AS A SUBSTITUTION IN ACCORDANCE WITH PROVISIONS OF THE INSTRUCTIONS TO BIDDERS AND SECTION 01 6000 OF THE SPECIFICATIONS:

8.01 SPECIFIED PRODUCT OR SYSTEM

- A. Substitution request for: _____
B. Specification Section No.: _____ Article: _____

8.02 SUPPORTING DATA

- A. Product data for proposed substitution is attached (description of product, reference standards, performance and test data).

8.03 QUALITY COMPARISON

- A. SPECIFIED PRODUCT SUBSTITUTION
1. Name Brand: _____
2. Catalog No. _____
3. Manufacturer: _____
4. Vendor: _____
5. Variations: _____
6. (Add additional sheets if necessary)
7. Maintenance Service Available: Yes No
8. Spare Parts Source: _____
9. Warranty: Yes No _____ Years.

8.04 PREVIOUS INSTALLATIONS

- A. Identification of similar projects on which proposed substitution was used:
B. Project: _____ Project: _____
C. Address: _____ Address: _____
D. Architect _____ Architect _____
E. Owner _____ Owner _____
F. Date Installed _____ Date Installed _____

8.05 REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEM

- A. _____
B. _____

8.06 EFFECT OF SUBSTITUTION

- A. Proposed substitution affects other work or trades: NO Yes (If yes, explain)
1. _____
2. _____
3. _____

4. 4. Substitutions requires dimensional revisions or redesign of structural, M/E/P, or other work: No Yes (if yes, attach data explaining revisions).

8.07 BIDDER'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENTS

- A. I / we have investigated the proposed substitution.
- B. I / we believe that it is equal or superior in all respects to specified product, except as stated above.
- C. Will provide same warranty as specified for specified product:
- D. Have included complete cost data and implications of the substitution;
- E. Will pay redesign and special inspection costs caused by the use of this product:
- F. Will coordinate the incorporation of the proposed substitution into the Work:
- G. Waive future claims for added cost to Contract caused by the substitution.
- H.

8.08 BIDDER: _____

8.09 (NAME OF PRIME BIDDING CONTRACTOR)

8.10

- A. All questions must be answered and all blanks filled in. Enter "NA" if not applicable. Unresponsive or incomplete requests will be rejected and returned without review.

8.11 ARCHITECT'S REVIEW AND ACTION

- A. Resubmit substitution request: Yes No
- B. Provide more information in the following areas: _____
- C. _____
- D. _____
- E. Prime Bidder must sign Bidder's Statement of Conformance Yes
- F. Substitution is accepted. Yes No
- G. Substitution is accepted, with the following comments:
H. _____
I. _____
- J. Substitution request received too late. Yes No
- K. Architect:
- L.
 - 1. By: _____ Date: _____

THE ARCHITECT HAS RELIED UPON THE INFORMATION PROVIDED BY THE BIDDER, AND MAKES NO CLAIM AS TO THE ACCURACY, COMPLETENESS, OR VALIDITY OF SUCH INFORMATION. IF AN ACCEPTED SUBSTITUTION IS LATER FOUND TO BE NOT IN COMPLIANCE WITH THE CONTRACT DOCUMENTS, BIDDER SHALL PROVIDE THE SPECIFIED PRODUCT AT NO COST TO THE OWNER.

END OF SECTION

**SECTION 01 2900
PAYMENT PROCEDURES**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Procedures for submitting Applications for Payment.

1.02 GENERAL

- A. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning payment procedures.

1.03 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702 in accordance with Section 01 2973, Schedule of Values. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.

1.04 APPLICATIONS FOR PAYMENT

- A. Submit four (4) notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document CB, Supplementary Conditions of the Contract.
- E. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.
- F. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
 1. Current Record Documents as specified in Section 01 7700, Closeout Procedures, for review by Owner which will be returned to Contractor.
 2. Labor time sheets, purchase orders, or similar documentation.
 3. Affidavits attesting to off-site stored products.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 2973
SCHEDULE OF VALUES**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: 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. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.02 QUALITY ASSURANCE

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

1.03 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
 1. Meet with the Owner and determine additional data, if any, required to be submitted.
 2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.04 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
 1. Mobilization
 2. Clean Up
 3. Building Permit
 4. Bonds, Insurance
 5. Mechanical Accessories
 6. Demolition
 7. Rough-In Labor - (Electrical)
 8. Rough-In Material - (Electrical)
 9. Finish Labor - (Electrical)
 10. Finish Material - (Electrical)
 11. Allowances (listed separately)
 12. Record drawings and close-out documents
 13. Submittals listed separately per mechanical, electrical and plumbing
 14. Roof warranty as a line item
 15. Donated items individually itemized at \$0.00 (zero dollars).

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 3113
PROJECT COORDINATION**

PART 1 - GENERAL

1.01 REQUIREMENTS

- A. General: notify the Architect whenever there is need of clarification or interpretation of the Contract Documents prior to commencement of work.
- B. Commencement of work without Architect's prior notification means Contractor's acceptance of responsibility.
- C. Commencement of work without Architect's prior notification implies Contractor's understanding of conditions, assemblies, methods, or procedures.
- D. The project superintendent shall notify the Owner on an ongoing basis of ongoing work.

1.02 PRE-INSTALLATION CONFERENCE

- A. General: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable.
- B. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
 1. Division 2 – (Selective) Demolition.
 2. Division 3 - Installation of light weight concrete.
 3. 03 3000 - Excavation of grade beams.
 4. 03 3000 - Installation of concrete underlayment, vapor barriers, underslab water proofing
 5. 03 3000 - Placing of reinforcing, formwork, and concrete.
 6. Division 4 - Block, brick, and stone placement, glass unit masonry, masonry cleaning.
 7. 04 2000 - Placing of masonry, grout, and reinforcement.
 8. 05 5000 - Miscellaneous metals, ladders, brackets, pipe rails, etc.
 9. Division 6 - Finish Carpentry and Millwork
 10. Division 7 - installation of waterproofing, air barriers, vapor barriers, flashing and sheet metal.
 11. Division 7 - Installation of roofing system(s) and associated work.
 12. 07 2100 - Concealment of insulation.
 13. 07 9200 - Installation of building and glazing sealants.
 14. Division 8 - Installation of doors, frames, windows, and storefronts.
 15. Division 8 - Installation of rolling and coiling doors and grilles.
 16. 08 7100 - Installation of finish hardware
 17. 08 8000 - Installation of glazing and glazed systems
 18. Division 9 - Installation of plaster and gypsum board products.
 19. Division 9 - Installation of tile, flooring, and pavers.
 20. 09 5100 - Installation of acoustical ceiling (grid and panels).
 21. 09 6519 - Installation of resilient flooring and base.
 22. 09 9100 - Painting and staining (each coat).
 23. 09 7216 - Installation of wall coverings.
 24. Division 10 - Installation of specialty items, markerboards, display cases, projection screens, signage and graphics, canopies.
 25. 10 2813 - Installation of toilet accessories.
 26. Division 11 - Installation of appliances, stage curtain systems, library shelving, and shop equipment
 27. Divisions 22, 23 and 26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).

28. Division 22 - Installation of plumbing fixtures.
 29. Division 23 - Installation of heating, ventilating and air conditioning.
 30. Division 26 - Installation of all electrical fixtures.
 31. Divisions 22, 23 and 26 - Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
 32. 31 0000 - Clearing and stripping of top soil within limits of grading.
 33. 31 0000 - (Excavation and) Placing (of each lift of) select fill material, and site grading.
 34. 31 0000, 31 2323, and Divisions 22, 23 and 26 - Compaction, inspection, testing, and covering of underground utilities.
 35. Division 32 - Installation of site amenities, fencing, surfaces, landscaping, etc.
- C. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
1. Drilling, reinforcing, and placing of first piers and footings.
 2. Placing first reinforcing and grade beams.
 3. Erecting structural steel elements.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.

3.02 CONFERENCES AND MEETINGS

- A. Refer to Section 01 3119, Project Meetings for requirements pertaining to Pre- construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

**SECTION 01 3119
PROJECT MEETINGS**

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDE

- A. The Architect's:
 - 1. Scheduling of each meeting (pre-construction meeting, periodic project meetings, and specialty called meetings throughout the progress of the Work).
- B. The Contractor's:
 - 1. Preparation of agenda for meetings.
 - 2. Making physical arrangement for meetings.
 - 3. Participation in all meetings and conferences.
 - 4. Scheduling attendance of Job Superintendent, Project Coordinator, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
 - 5. Scheduling Pre-installation conferences.
 - 6. Scheduling Pre-Closeout Meeting
 - 7. Providing updated schedules.
 - 8. Providing status reports/logs of CPRs, MCs, and shop drawings/submittals.
 - 9. Presiding at minutes, including all significant proceedings and decisions.
 - 10. Recording, reproducing, and distributing copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 - 11. All participants in the meeting.
 - 12. All parties affected by decisions made at the meeting.
 - 13. Providing status report of allowance funds.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION CONFERENCE

- A. Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.
- B. Architect will:
 - 1. Administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
 - 2. Administer site mobilization conference for clarification of Owner and Contractor.
- C. Location: At Project site as designated by the Architect.
- D. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Coordinator (Manager)
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Major suppliers
 - 7. Architect's Representative
 - 8. Architect's Field Representative
 - 9. Consultants as needed
 - 10. Others as appropriate
- E. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on major subcontracts and suppliers and projected construction schedules.
 - 2. Critical work sequencing.

3. Major equipment deliveries and priorities. Discussion of long lead time items.
4. Project coordination and designation of responsible personnel.
5. Procedures and processing of field decisions, proposal requests, submittals, minor changes, change orders and applications for payment.
6. Method of distribution of Contract Documents.
7. Procedures for maintaining Record Documents.
8. Use of premises, office work and storage areas, on-site parking, and Owner's requirements.
9. Construction facilities and temporary utilities.
10. Housekeeping procedures.

3.02 PROGRESS MEETINGS

- A. Architect will:
 1. Schedule project meetings throughout progress of the work at weekly intervals, and specially called meetings.
 2. Set agenda and administer said meetings.
 3. Preside at meetings.
 4. Record meeting minutes, including all significant proceedings and decisions.
 5. Reproduce and distribute copies of meeting minutes within two (2) working days, excluding weekends and holidays, after each meeting to:
 6. All participants in the meeting.
 7. All parties affected by decisions made at the meeting.
- B. Contractor shall:
 1. Make physical arrangements for meetings.
- C. Attendance:
 1. Contractor or Contractor's Representative
 2. Job Superintendent
 3. Project Coordinator (Manager)
 4. Owner or Owner's Representative
 5. Major subcontractors
 6. Major suppliers
 7. Architect's Field Representative
 8. Consultants as needed
 9. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
 1. Review and approval of minutes of previous meeting.
 2. Review of Work progress since previous meeting.
 3. Field observations, problems, and conflicts.
 4. Review of off-site fabrication and delivery schedules.
 5. Corrective measures and procedures to regain projected schedule.
 6. Revisions to Construction Schedule.
 7. Plan progress and schedule during succeeding work period.
 8. Coordination of schedules.
 9. Review submittal schedules and expedite as required.
 10. Maintenance of quality standards.
 11. Allowance balances.
 12. Review of proposed changes and substitutions for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other contracts of the Project.
 13. Status of Allowance Expenditure Authorizations (AEAs).
 14. Status of Change Proposal Requests (CPRs).
 15. Status of Minor Changes (MCs).

16. Status of submittals, review of submittal log.
17. Other items and critical issues affecting Work.

3.03 PRE-INSTALLATION CONFERENCES

- A. In accordance with the requirements of Section 01 1100, Notification of Architect Requirements, the Contractor will convene pre-installation conferences when required by individual specification Sections or as required by the Architect, prior to the Contractor commencing Work of the Section.
- B. Attendance, optional:
 1. General Contractor or Contractor's Representative
 2. Project Coordinator (Manager)
 3. Owner or Owner's Representative
 4. Architect's Project Manager (Project Executive)
- C. Attendance, required:
 1. Project Superintendent
 2. Architect's Field Representative
 3. Sub-contractor's Project Manager
 4. Sub-contractor's Foreman
 5. Engineer's Representative, as needed.
 6. Manufacturer's Representative, as needed.
 7. Governing Agency Official, as required
 8. Inspection Agency Representative, as required.
 9. Others affecting or affected by Work.
- D. Meeting Agenda, may include, but is not limited to:
 1. Review of conditions of installation.
 2. Preparation and installation procedures.
 3. Coordination with related work
 4. Review of the contract document requirements.
 5. Review of code enforcement or testing requirements.
 6. Questions related to work required.

3.04 PRE-CLOSEOUT MEETING

- A. In accordance with the requirements of Section 01 7700, Closeout Procedures, the Contractor will convene a pre-closeout meeting when he considers the Work or designated portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the work for its intended use.
- B. Attendance, required:
 1. Owner or Owner's Representative
 2. Project Coordinator (Manager)
 3. General Contractor or Contractor's Representative
 4. Project Superintendent
 5. Architect's Project Manager (Project Executive)
 6. Architect's Field Representative
 7. Engineer's Representative, as needed.
- C. Meeting Agenda, may include, but is not limited to:
 1. Review of the contract document requirements for Substantial Completion and Project Closeout
 2. Review of Work which remains to be completed or corrected.
 3. Closeout Document review schedule and log
 4. Review of closeout procedures including, but not limited to Record Drawings, Warrantees, Operation and Maintenance Manuals, and Owner Demonstrations and Start-up.
 5. Review of code enforcement or testing requirements.

6. Questions related to work required.

END OF SECTION

SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for preparation of Construction Schedules for the Work of This Contract.
 - 1. Create a Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) schedules. Provide printed activity listings and bar charts in formats described in this Section.
 - 2. Combine activity listings and bar charts with a narrative report to form the Contractor's Construction Schedule submittal to the Architect.
- B. Related Sections:
 - 1. 01 3113 – Project Coordination
 - 2. 01 3119 – Project Meetings
 - 3. 01 3300 – Submittal Procedures
 - 4. 01 7700 – Close-out Procedures

1.02 DEFINITIONS

- A. Activity: A task or discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling construction of the 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 activities are activities that must be completed before another given activity can be started.
- B. CPM: Critical Path Method, a method of planning and scheduling a construction project in which activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the 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 the Contract completion dates.
 - 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. Fragnet: A partial fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or other 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.

1.03 SUBMITTALS

- A. Arrange the following information in a tabular format.
 - 1. Specification section number and title
 - 2. Name of subcontractor

3. Description of the Work covered
 4. Scheduled date for first submittal from vendor coordinated with construction schedule
 5. Scheduled date for Architect's final release or approval
 6. Submittal category (action or informational)
 7. Fabrication time
 8. Date material to be delivered to site
- B. Preliminary Construction Schedule:
1. Phasing of construction:
 - a. Preconstruction services
 - b. Construction services
 - c. Major Areas
 - d. Close-out
 2. Owner coordinated activities as identified in the Contract Documents.
 3. Milestones:
 - a. Project mobilization and demobilization
 - b. Concrete slab completion
 - c. Paving completion
 - d. Envelope dry-in
 - e. Climate control initiation
 - f. Final cleaning
 - g. Close-out
 - 1) Final inspection and testing
 - 2) Owner training
 - 3) Punchlist re-walk
 - 4) Close-out document submission
 4. The scheduling software shall be capable of producing activity listings and bar charts with the following information for each activity in the schedule:
 - a. Activity ID
 - b. Activity Description
 - c. Estimated (Original) Duration
 - d. Percentage Complete
 - e. Early Start Date
 - f. Late Start Date
 - g. Early Finish Date
 - h. Late Finish Date
 - i. Free Float
 - j. Total Float
 - k. Activity Codes (for Major Areas, work types, specification sections, subcontractors, etc.)
 5. Predecessor-successor listing sorted by Activity ID which meets the criteria outlined in this section and which is produced by the Contractor's approved scheduling software.
 6. Include a logic network diagram with the first construction schedule submittal.

1.04 QUALITY ASSURANCE

- A. Pre-scheduling Conference: Conduct conference at Project site. Review method and procedures related to the Preliminary Construction Schedule and Project Construction Schedule, including but not limited to the following:
1. Review software limitations and content and format for reports
 2. Verify availability of qualified personnel needed to develop and update schedule
 3. Discuss constraints
 4. Review delivery dates for Owner-furnished products
 5. Review schedule for work of Owner's separate constraints
 6. Review time required for review of submittals and re-submittals

7. Review requirements for tests and inspections by independent testing and inspecting agencies
8. Review time required for completion and startup procedures
9. Review and finalize list of construction activities to be included in schedule
10. Review submittal requirements and procedures
11. Review procedures for updating schedule

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 Project 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 in proper sequence.

1.06 RELIANCE UPON SCHEDULE

- A. The Construction Schedule as reviewed by the Architect will be an integral part of the Contract and will establish conditions for various activities and phases of construction.

PART 2 - PRODUCTS

2.01 PROJECT CONSTRUCTION SCHEDULE, GENERAL

- A. Prepare schedules using an industry-accepted software program developed specifically to manage construction project schedules.

2.02 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within ten (10) days of Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for the duration of construction.

2.03 PROJECT CONSTRUCTION SCHEDULE

- A. General: Prepare network diagrams using the Precedence Diagramming Method (PDM).
- B. CPM Schedule:
 1. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 2. Use "calendar days" as the unit of time, not to exceed the number of calendar days identified in the Contract Documents.
 3. Activity durations shall be limited to 15 calendar days, excepting only submittal review and approval, fabrication and delivery or other exceptions as approved by the Owner.
- C. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start- total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 1. Description of activity
 2. Principal events of activity
 3. Immediate preceding and succeeding activities
 4. Designated critical path
 5. Early and late start dates
 6. Early and late finish dates
 7. Activity duration in workdays
 8. Total float or slack time

- D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed
 2. Changes in early and late start dates
 3. Changes in early and late finish dates
 4. Changes in activity durations in workdays
 5. Changes in the critical path
 6. Changes in total float or slack time
 7. Changes in the Contract Time

PART 3 - EXECUTION

3.01 PROJECT CONSTRUCTION SCHEDULE

- A. Meetings: Provide look-ahead schedule generated from construction schedule software for review at each Subcontractor Coordination and OAC Meeting.
- B. Project Construction Schedule Updating: At monthly intervals, on a regular monthly date specifically identified in the pre-construction conference, the Contractor shall update the schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting. Submit schedule with each application for payment.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including but not limited to, changes in logic, duration, actual starts and finishes, and activity duration.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their portion of the Work and are no longer involved in performance of construction activities.
- D. Recovery: If at any time during the course of the project, the critical path demonstrates the project is in excess of 15 calendar days behind schedule the Contractor shall provide within 5 days of notification, revisions to the schedule demonstrating the ability to return the project to the milestone and project delivery dates identified in the Contract Documents. In addition, the Contractor will revise all remaining work as necessary to reflect any changes in the planned execution.

END OF SECTION

**SECTION 01 3300
SUBMITTAL PROCEDURES**

PART 1 - GENERAL

1.01 SUBMITTAL PROCEDURES

- A. Transmit to the Architect/Engineer each item indicated in individual specification sections with approved form identifying:
 1. Date of submission and dates of any previous submissions.
 2. Project title and number
 3. Contract identification
 4. Names of Contractor, Supplier, Manufacturer
 5. Pertinent drawing sheet and detail number, and specification section number, as appropriate
 6. Deviations from Contract Documents.
- B. Contractor shall be responsible for initial review prior to submittal to Architect/Engineer to verify adequacy and conformance to contract requirements. Lack of review by Contractor may be grounds for rejection.
- C. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and contract documents.
- D. Transmit each item in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor. Allow minimum of ten
- E. (10) days for adequate Architect/Engineer review of each submittal. Time may vary according to scope and complexity of item under review. Allow adequate time in schedule for revisions and resubmittal as deemed necessary.
- F. Submit one (1) copy of the submittal to the Architect via electronic original. Transmit the electronic copy of consultant and engineering submittals directly to respective consultants with a transmittal and the electronic original to the Architect. The Architect and Consultant will make up the electronic copy and return to the Contractor upon completion of review. It will be the Contractors responsibility to maintain and distribute up-to-date reviewed submittals to all concerned parties.
- G. Submit each item according to individual specification sections and identified by Division, Section, and individual submittal number. Maintain log according to each Division.
- H. Revise and resubmit submittal as required; identify all changes made since previous submittal.
 1. Make any corrections or changes in the submittals required by the Architect/Engineer and resubmit until approved.
 2. Submit new submittal as required for initial submittal.

1.02 PROPOSED PRODUCTS LIST

- A. Within 30 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.03 PRODUCT DATA

- A. Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, one (1) additional set for the Owner and one (1) additional set for each of the Architect's consultants involved with the particular Section of Work.

- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project

1.04 MSDS SHEETS

- A. The Texas Asbestos Health Protection Rules (Title 25. Health Services, Part I. Texas Department of Health Chapter 295 - Occupational Health, Subchapter C - Texas Asbestos Health Protection) were approved and became effective on October 20, 1992, and amended March 27, 2003. The Rules established the procedures and means to implement the provisions of Senate Bill 1341 and House Bill 79.
- B. Pursuant to the above referenced Rules, submit MSDS Sheets showing that materials used in the Project, contain 1.0 percent or less asbestos. This requirement pertains to every material in every Section of the Specifications, as applicable to the Project, whether written therein, or not. Submit MSDS Sheets for materials, including, but not limited to the following, as applicable to the Project.
1. Surfacing Materials:
 - a. acoustical plaster;
 - b. decorative plaster/stucco;
 - c. textured paint/coating;
 - d. spray applied insulation;
 - e. blown-in insulation
 - f. fire proofing insulation;
 - g. joint compound; and
 - h. spackling compounds
 2. Thermal System Insulation:
 - a. taping compounds (thermal)
 - b. HVAC duct insulation;
 - c. boiler insulation;
 - d. breaching insulation;
 - e. pipe insulation; and
 - f. thermal paper products
 3. Miscellaneous Material:
 - a. cement wallboard/siding;
 - b. asphalt/vinyl floor tile
 - c. vinyl sheet flooring/vinyl wall coverings;
 - d. floor backing;
 - e. construction mastic;
 - f. ceiling tiles/lay-in ceiling panels;
 - g. packing materials;
 - h. high temperature gaskets;
 - i. laboratory hoods/table tops
 - j. fire blankets/curtains;
 - k. elevator equipment panels;
 - l. elevator brake shoes;
 - m. ductwork flexible fabric connections;
 - n. cooling towers;
 - o. heating and electrical ducts;
 - p. electrical panel partitions;
 - q. electrical cloth/electrical wiring insulation;
 - r. chalkboards;
 - s. roofing shingles/tiles;
 - t. roofing felt;
 - u. base flashing;
 - v. fire doors;

- w. caulking/putties;
- x. adhesives/mastics; and
- y. wallboard

1.05 SHOP DRAWINGS

- A. Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

1.06 SAMPLES

- A. Submit for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit for aesthetic, color, or finish selection. Submit full range of manufacture's standard colors, textures, and patterns for Architect's selection.
- C. Submit samples to illustrate functional characteristics of the Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- D. Submit the number specified in respective Specification Section; minimum of two (2), of which one (1) will be retained by Architect.
- E. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- F. Samples will not be used for testing purposes unless specifically stated in specification section.

1.07 DESIGN DATA

- A. When required, submit for Architect/Engineer's knowledge as contract administrator or for Owner.
- B. Submit design data for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.08 TEST REPORTS

- A. In accordance with Section 01 4523, Inspection and Testing Laboratory Services, submit test reports for Architect/Engineer's knowledge as contract administrator or for Owner. Architect will determine whether corrective action is required.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.09 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect, in quantities specified.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and Owner.

- D. Submit required certificates in duplicate.

1.10 GUARANTEES

- A. When specified in individual specification sections, submit warranties by manufacturer, installation/application subcontractor, fabricator, or Contractor to Architect, in quantities specified.
- B. Submit warranties in accordance with Section 01 7700, Closeout Procedures.

1.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect for delivery to Owner in quantities specified.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Submit required instructions in duplicate.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
- B. Submit report in quantity specified or required within ten (10) days of observation to Architect for information. Architect will determine whether corrective action is required.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

- A. When required, submit drawings for Architect/Engineer's benefit or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner. Architect will determine whether corrective action is required.

1.14 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs monthly of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect/Engineer.
- B. Photographs: digital; sent to Architect via email, or provide on non-rewritable compact disk. Along with Application for Payment, include one (1) reproducible copy of contact sheet of all photographs taken during that period indicating Work completed and identified as stated below.
- C. Photograph project conditions five (5) days maximum prior to submitting indicating relative progress of the Work. Do not photograph conditions previously photographed if no work has proceeded. As able, take photographs from same position indicating same view in successive installments.
- D. Take photographs as evidence of existing project conditions as follows:
 1. Site: Take four (4) site photographs at project corners
 2. Interior views: Take two (2) minimum interior photographs of each space under construction from differing directions or as required.
 3. Exterior views: Take two (2) photographs of each elevation.
 4. Details: Take as required to document concealed conditions, including, but not limited to, underground construction, utility penetrations and installation, steel erection, concrete and masonry reinforcing, waterproofing and flashing, and roofing installation.
 5. Cavity wall: Provide photographic evidence that cavity wall was maintained clean and free of debris and excess mortar.
- E. Identify each photograph with name of Project, room or view, and date.

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 4500
QUALITY CONTROL**

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation.
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

1.02 RELATED SECTIONS

- A. Section 01 4523 – Testing and Inspecting Services
- B. Section 01 3300 - Submittal Procedures
- C. Section 02 3200 - Geotechnical Report
- D. The Work of this Section shall be included as a part of all Sections of Work, whether referenced therein or not.

1.03 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all Work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 1. perform Work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section;
 2. perform Work in the highest quality workmanship, unless specified otherwise;
 3. join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work;
 4. install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials;
 5. attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed;
 6. use concealed fasteners, unless shown or directed otherwise.

1.04 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.

- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.05 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.06 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.
- F. Refer to Section 01 41 00, Codes, Regulations and Standards, for additional information concerning applicable reference and standards requirements.

1.07 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining Work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.
- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample panel with the following properties:
 1. Size: Minimum 6 feet wide by 8 feet tall. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 16 inches long. Brick and Mortar color shall be selected by Architect prior to mock-up assembly.

3. Drawing: Refer to mock-up diagram on Drawings for minimum project requirements.
Mock-up drawing is for reference only. Actual mock-up drawing will be submitted by the Architect after submittals have been approved.

1.08 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform Work to contract requirements.
- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 23, Inspection and Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.09 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
- F. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- G. Inspecting does not relieve Contractor to perform Work to contract requirements.
- H. Refer to Section 01 4523, Inspection and Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of

surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.

- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning
- E. submittal procedures and requirements for Manufacturers Field Reports.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 4523
TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner and approved by Architect, will perform professional testing and laboratory services specified herein.
- B. Inspecting agency shall make and perform all inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and these Contract Documents.
- C. Materials and workmanship not meeting required standards or performance obligations are to be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- D. Where terms "Inspector" and "Laboratory" are used, they mean and refer to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.
- E. All testing laboratory services will be provided and paid for by the Owner and the Contractor shall be notified as soon as possible.
- F. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and re-testing of materials that do not comply with the requirements of the Contract Documents.
- G. Laboratory inspection shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. Contractor or Fabricator shall cooperate with the testing laboratory in all matters pertaining to the work.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals or public authorities.
- B. Respective Sections of Specifications. Certification of products.
- C. Each Specification Section Listed: Inspection and laboratory test required and standards for inspection and testing.
- D. Testing laboratory inspection, sampling and testing is required for:
 - 1. Section 31 0000 - Earthwork
 - 2. Section 31 2300 - Construction of Underground Utilities
 - 3. Section 31 3213.19 - Soil Stabilization: As specified or required by geotechnical report and/or project conditions.
 - 4. Section 31 6213.16 - Drilled and Reamed Foundation
 - 5. Section 32 1313 - Concrete Paving
 - 6. Section 32 1216 – Hot Mix-Hot Laid Asphaltic Concrete Paving
 - 7. Section 03 3000 - Cast-In-Place Concrete
 - 8. Section 04 2000 - Unit Masonry
 - 9. Division 05 - Metals: As specified or required for structural steel, open web steel joists, steel deck, miscellaneous metals, etc.
 - 10. Division 07 - Thermal and Moisture Protection: As specified or required for waterproofing and roofing.
 - 11. Division 07 - Fireproofing and Intumescent Paint
 - 12. As requested by the Construction Manager/Contractor, Owner, Architect, or Engineer(s).

1.03 QUALIFICATIONS

- A. Testing agencies shall meet requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction" and ASTM E543, "Standard Practices for Agencies Performing Non-Destructive Testing".
- B. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.
- C. Inspection and testing services of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.
- D. Inspecting personnel monitoring concrete work shall be ACI certified inspectors.
- E. Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". Inspector may be supported by assistant inspectors who may perform specific inspection functions under supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing machines shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.

1.04 RESPONSIBILITIES OF CONTRACTOR

- A. See respective technical sections for specific requirements.
- B. Deliver to the laboratory, without cost to Owner, adequate quantities of representative samples of materials proposed for use which are required to be tested.
- C. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide adequate facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM C31.
- E. Furnish such nominal labor and equipment as is required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, Section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, the laboratory shall be selected and paid by the Contractor.
- G. Obtain required inspections or approvals of the building official. All inspection requests and notifications required by building code are responsibility of the Contractor.
- H. Provide current welder certificates for each welder to be employed.
- I. Furnish fabrication/erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6.
- J. Prequalification of all welding procedures to be used in executing the work.

1.05 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

- A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in all pre-construction conferences. He shall coordinate material testing and inspection requirements with the Contractor and his subcontractors consistent with the planned construction schedule. The laboratory representative shall attend, throughout the course of the project, such conferences as may be required or requested to address quality control issues.

- B. Laboratory personnel shall inspect and/or test materials, assemblies, specimens, and work performed, including design mixes, methods and techniques and report to the Architect the progress thereof.
- C. If material furnished and/or work performed fails to meet requirements of Contract Documents, laboratory inspector shall promptly notify the Construction Manager, Architect, Engineers, supplier and/or subcontractor providing or preparing the materials or work being tested of such failure.
- D. Laboratory technicians do not act as foremen, or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not, in any way, prevent later rejection when such defect is discovered.
- E. Laboratory inspector is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents or to approve or accept any portion of work, except where such approval is specifically called for in the Specifications.
- F. Comply with all building code requirements for "Special Inspection" whether or not such inspections are specified herein.

1.06 SUBMITTALS

- A. Submit copies of reports of each and every inspection and test as follows:
- B. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One (1) each
- C. Construction Manager, if applicable, and Contractor: Two (2) each
- D. State in report all details of each inspection and test. Indicate compliance or noncompliance with requirements of Contract Documents. Also state in report any and all unsatisfactory conditions.
- E. In addition to furnishing a written report, notify Construction Manager, if applicable, and Contractor verbally of any uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately Fax corresponding report to the Architect and Engineer.
- F. At completion of each trade or branch of work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of work and full compliance with requirements of Contract Documents.
- G. Submit copies of test results, sealed by a Registered Engineer, to municipal authorities having jurisdiction, as required.

1.07 REFERENCED STANDARDS

- A. Latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.08 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the Project site.
- B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight (8) hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.
- C. There will be a three (3) hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
- D. Cylinder pick-up will be handled by the technician performing test on a scheduled pick-up day. If there are no testing services scheduled, the cylinder pick-up fee will be \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.

- E. The Contractor shall bear the responsibility of scheduling all of the test services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations and/or failed test will be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. The Owner reserves the right to add to or delete any or all inspection and testing specified herein, excluding testing as required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. In any case the most stringent requirements shall dictate procedure.

3.02 TESTING OF EARTHWORK

- A. Testing Services (As specified or required):
 1. References (As applicable for tests required):
 - a. American Society for Testing and Materials (ASTM)
 - 1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³)
 - 2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth)
 - 3) D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - b. American Association of State Highway and Transportation Officials (AASHTO)
 - 1) T89, Determining the Liquid Limit of Soils
 - 2) T90, Determining the Plastic Limit and Plasticity Index of Soils
 - 3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop
 - 4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth)
 2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab-on-grade, and backfills.
 3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
 4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
 5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,
 6. Perform one (1) in place density test for each 2,500 square feet (280 square yards) of existing subgrade material.
 7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one (1) type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
 8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one (1) test for each 2,500 square feet (280 square yards) of each lift of compacted fill.
 9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift

- B. Reports: Submit reports with the following information:
1. Type and condition of soil at footing bottoms.
 2. Level of water table in the excavated areas.
 3. Grain size distribution of fill materials (average of three (3) tests).
 4. Moisture density test results.
 5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
 6. Notify Architect by telephone within one (1) hour of the discovery of the following conditions and follow up telephone notification with written report.
 - a. Materials used, or degree of soil compaction not meeting specified requirements.
 - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
 - c. Water in excavations which is not being removed prior to work being performed in excavation.

3.03 INSPECTION OF PIPED SITE UTILITIES

- A. Laboratory representative shall observe and report on the following:
1. Proper alignment and grade of trenches.
 2. Pipe bedding and supports.
 3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
 4. Installation of pipe and joints.
 5. Testing of piped utilities performed by Contractor.

3.04 PAVING

- A. Testing Services:
1. Perform field tests for moisture density properties:
 - a. Provide field testing of the sub-grade as described in Paragraph 3.2, A, above.
 - b. Paving sub-base, provide one (1) field test for every 5,000 square feet of area of crushed limestone or caliche sub-base, if any.
 - c. Lime treated sub-grade, provide one (1) field test for every 5,000 square feet of area of lime treated sub-grade, if any, for content of lime and sub-grade compaction.
 - d. Cement soil stabilization, if any, provide one (1) field test for every 5,000 square feet of area of cement stabilized sub-grade for content of cement and sub-grade compaction.

3.05 PIER DRILLING OPERATION

- A. A representative of a qualified geotechnical laboratory shall provide services herein specified.
- B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.
- C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.
- D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
1. Verify soundness of bearing stratum and desired penetration.
 2. Verify pier dimensions and reinforcing used.
 3. Monitor condition of hole and removal of water and loose material from bottom.
 4. Monitor placement of concrete and use of tremie or pumps.
 5. Monitor the extraction of casing, if used.
- E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.06 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. All instances of noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and then, if uncorrected, reported to the Architect.
- B. Laboratory representative shall observe and report on the following:
 1. Number and size of bars.
 2. Bending and lengths of bars.
 3. Splicing.
 4. Clearance to forms, including chair heights.
 5. Clearance to sides and bottom of trench if soil formed.
 6. Clearance between bars or spacing.
 7. Rust, form oil, and other contamination.
 8. Grade of steel.
 9. Securing, tying, and chairing of bars.
 10. Excessive congestion of reinforcing steel.
 11. Installation of anchor bolts and placement of concrete around such bolts.
 12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three (3) years experience inspecting reinforcing steel in projects of similar size.

3.07 CONCRETE INSPECTION AND TESTING

- A. Receive and evaluate all proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.
- B. Comply with ACI 311, "Guide For Concrete Inspection" and ACI "Manual of Concrete Inspection" (SP-2).
- C. Sample and test concrete placed at the job site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.
- D. All concrete shall be tested as follows:
 1. Mold and cure four (5) specimens from each sample.
 - a. for each 50 cubic yards or fraction thereof of structural building concrete; and
 - b. for each 100 cubic yards or fraction thereof of non-structural concrete and site work paving and sidewalks.
 - c. Laboratory cure two (2) cylinders in accordance with ASTM C192.
 - d. Field cure remaining cylinders in accordance with ASTM C31.
 2. TWO (2) specimens shall be tested at seven (7) days for information, two (2) shall be tested at 28 days for acceptance, and
 3. Store one (1) cylinder for testing at 56 days in the event the 28 days strength tests do not meet strength requirements.
- E. All deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.
- F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.

- G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.
- H. Make one (1) strength test (four (4) cylinders) of each mix design of concrete placed in any one (1) day.
- I. Make one (1) slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- L. Determine temperature of concrete sample for each strength test.
- M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
 - 1. Monitor addition of water and high-range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.
- N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and coarse aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.
- O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.
- P. Observe placing of all concrete, except non-structural slabs-on-grade and site work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.
- R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
- S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.
- T. Evaluation and Acceptance:
 - 1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event

- of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
2. Strength level of concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two (2) cylinders) is below specified strength by more than 500 psi.
 3. Completed concrete work will be accepted when requirements of "Specifications for Structural Concrete for Buildings", ACI 301, Chapter 18, have been met.
- U. Concrete Test Reports:
1. Reports shall be made and distributed immediately after respective tests or inspections are made.
 2. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.
- V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
1. Strength tests at seven (7) days.
 2. Strength tests at 28 days of two (2) cylinder averages.
 3. 28-day moving average strength tests of last three (3) test groups.
 4. Standard deviation and coefficient of variation based on 28 day strength tests.
 5. Average strength and number of 28 days tests for most recent month.
 6. Strength test one (1) cylinder at 56 days in the event the 28 days strength tests do not meet strength requirements.
- W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type as specified for other footings, placed in same manner. Accepted test footings may be used in the Work.
- X. Non-Compliant Test Reports: All test reports indicating non-compliance should be faxed immediately to all parties on the test report distribution list. Copies shall be on different colored paper.
- Y. Inspect application of curing compound and monitor all curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.08 TESTING OF NON-SHRINK GROUT

- A. Make one (1) strength test for all plates grouted and for all grout used in joints between members.
- B. Each test shall consist of four (4) cubes, two (2) to be tested at seven (7) days and two (2) at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.09 STRUCTURAL STEEL

- A. Inspect structural steel during and after erection for conformance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.
- B. Field Inspection:
 1. Proper erection of all pieces.
 2. Proper touch up painting of all shop primed structural steel exposed to view or in a crawl space.
 3. Proper installation of all bolts.
 4. Plumbness of structure and proper bracing.
 5. Proper field painting.
 6. Initial inspection of welding process and periodically thereafter, as necessary.
 7. Visual examination of all completed welds.
 8. Ultrasonic testing of all penetration field welds.

9. Installation of field welded shear studs.
 10. Inspect all shop fabricated members, upon their arrival at the jobsite, for defects incurred during transit and handling.
 11. Measure and record camber of all beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Members outside specified camber tolerance shall be returned to shop for correction.
- C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed on work, along with certification that each welder has passed qualification tests within the last 12 months, using procedures covered in AWS D1.1, "Structural Welding Code - Steel", latest edition. Verify all welder qualifications.
- D. Inspection of field welding shall include the following:
1. Visually inspect fillet welds for size, soundness, and proper return around ends. Check for seams, folds, and delaminations.
 2. Visually inspect all welds for proper repair of painting.
 3. Ultrasonically test all penetration welds in accordance with ASTM E164.
 4. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted. Electrodes shall be checked for size, type and condition.
 5. Welding inspector shall be present during alignment and fit-up of members being welded, and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and re-welded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and re-welded to two (2) inches beyond each end of crack.
 6. Inspector shall check that all welds have been marked with welder's symbol and shall mark welds requiring repairs and shall make a re-inspection. Inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector. Unacceptable material and work shall be identified by word "reject" or "repair" marked directly on the material.
 7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other than those specified. Such further tests and examinations shall be performed as authorized by the Owner and Architect.
 8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
 9. Weld quality to comply with the American Institute of Steel Construction Manual of Steel Construction.
 10. Percentage of weld tested will be determined by the number of welds that fail the initial testing.
 11. All welds that fail shall be re-welded and re-tested until they pass. Test two (2) additional welds for every weld failure at the Contractor's expense.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" as follows:
1. All bolts shall be visually inspected to ensure that plies have been brought into snug contact.
 2. High strength bolting shall be inspected in accordance with Section 9 of the "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
- F. Inspection of stud welding shall be in accordance with Section 7.8, of the AWS D1.1, Structural Welding Code, and as follows:
1. Minimum of two (2) shear studs shall be welded at the start of each production period in order to determine proper generator, control unit and stud welder setting. These studs shall be capable of being bent 45 degrees from vertical without weld failure.
 2. When temperature is below 32 degrees F, one (1) stud in each 100 shall be tested after cooling. Studs shall not be welded below 0 degrees F or when surface is wet with rain or

- snow. If stud fails in the weld, two (2) new studs shall pass the test before resumption of welding.
3. Visually inspect studs for compliance with Contract Documents. Check, number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing under this test shall be replaced.

3.10 REINFORCING STEEL MECHANICAL SPLICES

- A. Inspection and Observation Services:
 1. Visually inspect and report on the completed condition of each mechanical splice of reinforcing steel.
 2. Reports and the manufacturer's published criteria for acceptable completed splices.
 3. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the I.C.B.O. Report.
- B. Reports: Submit reports to Architect with the following information:
 1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
 2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Reasons for rejection shall be shown on each report.

3.11 OPEN WEB JOISTS AND JOIST GIRDERS

- A. Inspect all joists at jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members.
- B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with Contract Documents and referenced standards.
- C. Check welder qualification certificates for both shop and field welding operators.

3.12 METAL FLOOR DECK

- A. Field inspection shall consist of the following:
 1. Checking types, gauges and finishes for conformance with Contract Documents and shop drawings.
 2. Examination of composite floor deck exposed to crawl space, for damage to galvanizing due to welding or other construction activities. Galvanized composite floor deck shall be repaired in accordance with these specifications.
 3. Examination for proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
 4. Certification of welders.
 5. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the paragraph addressing structural steel.

3.13 METAL ROOF DECK

- A. Field inspection shall consist of the following:
 1. Checking types, gauges and finishes for conformance with Contract Documents and shop drawings.
 2. Examination for proper erection of all metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
 3. Certification of welders.
 4. Visual inspection of at least 25 (twenty-five) percent of all welds.

3.14 SPRAYED FIREPROOFING (WHEN APPLICABLE)

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify that installation meets fire rating requirements of approved design.
- C. Inspect and test for thickness as follows:
 1. Test twenty-five (25) percent of structural frame columns and beams in each building level.
 2. Test ten (10) percent of beams other than structural frame in each building level.
 3. Test one (1) slab per 5,000 square feet of building area.
- D. Inspection and test procedures in accordance with ASTM E605 and E736.

3.15 EXPANSION BOLT INSTALLATION

- A. Inspect drilling of each hole and installation of each expansion bolt for conformance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.16 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services (As required):
 1. Inspection of roof deck prior to start of work.
 2. Inspection during installation of insulation and lightweight insulating concrete fill work to ascertain compliance with Contract Documents.
 3. Observation of base ply fastener pull tests performed by Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.
- B. Testing Services (As required):
 1. References (As applicable for tests required):
 - a. American Society for Testing and Materials (ASTM)
 - 1) C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded-Hot-Plate Apparatus
 - (a) C495, Test Method for Compressive Strength of Lightweight Insulating Concrete
 - (b) C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation
 2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
 3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
 - a. Mix design compressive strength.
 - b. Mix design wet and dry density range.
 - c. Number of Tests:
 - 1) One (1) per 5,000 square feet
 - 2) Not less than one (1) for each day's work
 4. Test EPS insulation board for density in accordance with ASTM C578.

3.17 TESTING OF ROOFING

- A. Inspection and Observation Services (As required):
 1. Inspection of roof deck prior to start of work.
 2. Inspect on-site condition of stored roofing materials.
 3. Inspection during roofing, roof insulation, and sheet metal work to ascertain compliance with Contract Documents.
 4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
 5. Observation of patching of roof test cuts to ascertain that they are properly made.
- B. Testing Services (As required):

1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.

3.18 MASONRY

- A. Inspection and Observation Services:
 1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
 2. Review mortar design mixes.
 3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)
 - 1) C140, Standard Test Methods of Sampling and Testing Concrete Masonry Units
 - 2) C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
 - 3) C1019, Standard Test Method for Sampling and Testing Grout
 - 4) E447-97, Standard Test Methods for Compressive Strength of Laboratory Constructed Masonry Prisms
 2. Testing of Concrete Masonry Units (CMU):
 - a. Preconstruction: Perform the following tests in accordance with ASTM C140.
 - 1) Compressive Strength
 - 2) Absorption
 - 3) Weight
 - 4) Moisture Content
 - 5) Dimensions
 3. Mortar Tests:
 - a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
 - 1) 28 Day Compressive Strength
 - 2) Water Retention
 - b. Construction: Perform 28 day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 4. Refer to and include work for reinforcing steel specified in Paragraphs 3.5 and 3.6 above.
 5. Grout Tests:
 - a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
 - 1) Slump Test
 - 2) 28 Day Compressive Strength
 - 3) Construction: Perform 28 day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 - 4) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM E447- 97, Method B.

END OF SECTION

SECTION 01 4529
STRUCTURAL TESTING AND INSPECTIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes requirements for quality assurance and quality control to be completed by the Testing Laboratory, the Special Inspector, Contractor, and/or the Geotechnical Engineer for the following structural items:
1. Concrete Forming and Accessories.
 2. Concrete Reinforcing.
 3. Precast Structural Concrete
 4. Cast-in-Place Concrete.
 5. Post-Tensioned Concrete.
 6. Masonry.
 7. Structural Steel.
 8. Steel Decking.
 9. Earthwork.
- B. Related Requirements:
1. Specification 014000 "Quality Requirements" for other independent testing agency procedures and administrative requirements.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Unit Prices:
1. Cost Proposal: The Testing Laboratory's proposal to the Owner shall contain unit price stipulations for specified tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.
- B. Measurement and Payment
1. Payment of the Testing Laboratory: The Owner will pay for the initial Laboratory services for inspection and testing of materials for compliance with the requirements of the Contract Documents.
 2. Payment for Substitution Testing: The Contractor shall arrange for and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.
 3. Payment for Retesting: When initial tests indicate work does not comply with the requirements of the Contract Documents, the Contractor shall be liable to the Owner for the cost for any additional inspections, sampling, testing, and retesting done by the Testing Laboratory.
 4. Payment by Contractor: The Contractor shall furnish and pay for the following items if required:
 - a. Soil survey of the location of borrow soil materials, samples of existing soil materials, and delivery to the Contractor's Testing Laboratory.
 - b. Samples of concrete aggregates and delivery to the Contractor's Testing Laboratory.
 - c. Concrete mix designs as prepared by his concrete supplier.
 - d. Site-situated storage boxes for concrete cylinders
 - e. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.
 - f. Certification of reinforcing steel and prestressing steel mill order.
 - g. Certification of structural steel mill order.
 - h. Certification of portland cement, lime, fly ash.
 - i. Certification of welders and preparation of Welding Procedure Specifications.

- j. Tests, samples, and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect or Engineer to establish equality with specified items.
- k. The making and testing of concrete cylinders for the purpose of evaluating strength at time of form stripping or for post-tensioning or the time spent evaluating the in situ strength of concrete using the Maturity Method.
- l. Any other tests when such costs are required by the Contract Documents to be paid by the Contractor.
5. Payment for Tests of Suspected Deficient Work: If, in the opinion of the Building Official, Owner, Architect, or Engineer, any of the work of the Contractor is not satisfactory, the Contractor shall furnish and pay for all tests that the Owner, Architect, or Engineer deem advisable to determine its proper construction.

1.04 OWNER RESPONSIBILITIES

- A. The Owner shall engage a Geotechnical Engineer to provide inspection services for the foundations as outlined below in Article 3.7.
- B. The Owner shall provide a copy of the project plans and specifications to the Testing Laboratory prior to the start of construction and prior to any preinstallation meetings.

1.05 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall not engage the same Testing Laboratory for construction services as the Owner has for Structural Testing Laboratory Services as defined herein unless agreed to by the Owner.
- B. Furnishing Samples and Certificates: The Contractor shall provide to the laboratory certificates and representative samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.
- C. Furnishing Casual Labor, Equipment and Facilities: The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the laboratory and otherwise facilitate the required inspections and tests.

1.06 TESTING LABORATORY RESPONSIBILITIES

- A. The Testing Laboratory shall sample and test materials as they are being installed for compliance with specified acceptance criteria. The Testing Laboratory will report and interpret the test results. The Laboratory shall monitor and report on the installation of construction work and shall perform tests on the completed construction as required to indicate Contractor's compliance with the various material specifications governing this work.
- B. The Testing Laboratory shall serve as a Special Inspector to provide Special Inspection services for the items listed below. The scope of such services for each item shall be as defined in the Building Code or as defined in the local building code of the jurisdiction wherein the project is located. These inspections are mandatory for conformance to the legal requirements of the building code and shall be in addition to the inspections and tests otherwise defined in this specification.
 1. Special Inspector Responsibilities:
 - a. The special inspector shall observe the work assigned to ascertain that, to the best of his/her knowledge, it is in conformance with the approved design drawings and specifications.
 - b. The special inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.
 - c. The special inspector shall create and maintain a log of all discrepancies throughout the duration of the Project. This log shall include, but is not limited to, discrepancy date, description of discrepancy, drawing and/or detail reference, description of as-built condition, description of any remedial work performed, and status of

discrepancy. This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below.

- d. The special inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.
- C. The Testing Laboratory shall provide inspections on the following items:
 1. Reinforcing steel placement.
 2. Concrete work.
 3. Welding of reinforcing steel.
 4. Bolts to be installed in concrete.
 5. Bolts, anchors, and reinforcing bars installed in hardened concrete (post-installed anchors).
 6. Prestressing tendons placement.
 7. Prestressing operation.
 8. Grouting of bonded prestressing tendons.
 9. Inspection of structural steel, bolting, and welding material.
 10. Welding of structural steel.
 11. High-strength bolting.
 12. Compacted earth fill.
 13. Masonry work.
- D. Inspections Required by Government Agencies: The Testing Laboratory shall perform inspections and submit reports and certifications as required by government agencies having jurisdiction over the aspects of the project covered by this specification.
- E. Notification of Deficiencies in the Work: The Testing Laboratory shall notify the Architect, Engineer, and Contractor within 24 hours of discovery of observed irregularities and deficiencies of the Work and other conditions not in compliance with the requirements of the Contract Documents. Notification shall be by telephone or e-mail and then in writing.
- F. The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and costs attributed to the Contractor.
- G. Monitoring Product and Material Certifications: The Testing Laboratory shall be responsible for monitoring the submittals of product and material certifications from manufacturers and suppliers as specified in the Specifications and shall report to the Owner, Architect, and Engineer when those submittals are not made in a timely manner.
- H. Limitations of Authority: The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. The Testing Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.
 2. The Contractor shall cooperate with Testing Laboratory personnel and provide access to the work and to manufacturers' operations.
 3. Notification of Source Change: The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.
- B. Preinstallation Meetings: The Testing Laboratory shall attend preinstallation meetings with the Architect, Engineer, Contractor, and material suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule and shall participate in such meetings throughout the course of the project.

C. Scheduling:

1. Advance Notice: The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. Failure to sufficiently notify may result in additional costs incurred by the Testing Laboratory that may be back-charged to the Contractor by the Owner.

1.08 SUBMITTALS

A. Quality Control Reports:

1. Information on Reports: The Testing Laboratory shall submit copies of reports of inspections and tests promptly. The reports shall contain at least the following information:
 - a. Project name.
 - b. Date report issued.
 - c. Testing Laboratory name and address.
 - d. Name and signature of inspector/technician.
 - e. Date of inspection and/or sampling.
 - f. Date of test.
 - g. Identification of product and Specification section.
 - h. Location in the project.
 - i. Identification of inspection or test.
 - j. Record of weather conditions and temperature (if applicable).
 - k. Results of test regarding compliance with Contract Documents.
 2. Copies: The Laboratory shall send signed electronic (PDF) copies of test and inspection reports to the following parties:
 - a. Owner or his/her representative.
 - b. General Contractor.
 - c. Architect.
 - d. Engineer of Record.
- B. Discrepancy Log: The Testing Laboratory shall create and maintain a log of all discrepancies throughout the duration of the project.
1. Information on Log: This log shall include, but is not limited to:
 - a. Discrepancy date.
 - b. Description of discrepancy.
 - c. Drawing and/or detail reference.
 - d. Description of as-built condition.
 - e. Description of any remedial work performed.
 - f. Status of discrepancy.
 2. Submission Schedule: This log shall be submitted to the Architect/Engineer on a periodic basis for review and comment. Upon completion of the Project, this log shall be submitted in its entirety as an attachment to the final signed report described below under Certifications.
- C. Certification: Upon completion of the job, the Laboratory shall furnish to the Owner, Architect, and Engineer of Record, a statement signed by a licensed professional engineer that, to the best of their knowledge, required tests and inspections were made in accordance with the requirements of the Contract Documents.

1.09 QUALITY ASSURANCE

- A. Qualifications of Special Inspector: The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.
- B. Qualifications of Testing Laboratory:
1. The Testing Laboratory shall meet the basic requirements of ASTM E 329 and shall submit to the Owner, Architect, and Engineer evidence of current accreditation from the American

2. Association for Laboratory Accreditation, the AASHTO Accreditation Program or the "NIST" National Voluntary Laboratory Accreditation Program.
 3. The Testing Laboratory shall be an Approved Agency by the Building Official to perform Special Inspections and other tests and inspections as outlined in the applicable building code.
 4. Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.
 5. Qualifications of Welding Inspectors
 - a. Inspectors performing visual weld inspection shall meet the requirements of AWS D1.1 Section 6.1.4. Inspectors shall have current certification as an AWS Certified Welding Inspector (CWI). Assistant inspectors, if any, shall be supervised by an Inspector and shall be qualified by training and experience to perform the specific functions to which they are assigned.
 - b. Inspectors performing nondestructive examinations of welds other than visual inspection (MT, PT, UT, and RT) shall meet the requirements of AWS D1.1, Section 6.14.6.
- C. The Contractor shall not engage the same testing laboratory for construction services as the Owner has for quality assurance testing, unless agreed to by the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SCOPE OF WORK

- A. The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and as determined in meetings with the Owner, Architect, and Engineer.

3.02 CONCRETE FORMING AND ACCESSORIES

- A. Field Inspection:
 1. Shallow Foundation Elements:
 - a. Verify element width, length, depth, and elevation.
 - b. Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 2. Slabs-on-Grade:
 - a. Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.
 3. Columns and Walls:
 - a. Verify that forms are plumb and straight, braced against movement, lubricated for removal, and conform to approved shop drawings.
 - b. Verify proper dimensions and orientation.
 - c. Verify top of column elevation is set in form and that it is 1/2 inch below the future slab soffit.
 4. Suspended Floors (General):
 - a. Verify that formwork conforms to signed and sealed shop drawings.
 - b. Verify that shoring layout conforms to signed and sealed shop drawings.
 - c. Verify that reshores at all levels conform to signed and sealed shop drawings.
 - d. Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 - e. Verify that the forms used for exposed finish surfaces are of the type specified and provide a joint system as shown on the Architect's drawings.
 - f. Verify the proper dimensions of girders, beams, and joists.
 - g. Verify that the slab thickness and top of slab elevation is correct.
 - h. Verify the top of columns are 1/2 inch below the deck soffit.
 5. Pan Form Slabs:

- a. Verify that pans used are of the type specified and are free of dents, surface irregularities, sags, rust, or stains.
- b. Verify that the discontinuities that will be created in the slab soffit at the splice points of the pans do not exceed the value specified.
6. Flat Slabs:
 - a. Verify that the top of columns are 1/2 inch below the deck soffit.
7. In-Situ Concrete Strength Verification Prior to Form Stripping: The Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests. Refer to Paragraph 3.4C.2.a for additional information regarding the tests.

3.03 CONCRETE REINFORCING

- A. Quality Assurance:
 1. Review the Welding Procedure Specification (WPS) submitted by the contractor for any reinforcing steel other than ASTM A 706 that is proposed to be welded for consistency with acceptable welding practices and AWS.
 2. Review welder qualifications by certification or verify by retesting. Obtain welder certificates.
- B. Field Testing: The following tests shall be completed by the Testing Laboratory:
 1. Mechanical Tension Splices: The Laboratory shall conduct monotonic tension tests in accordance with ASTM A 1034 of mechanical tension splices of the type as specified on the structural drawings. It is not necessary that the specimens to be tested are production splices, however, the specimens to be tested shall have been made by the Contractor's personnel under field conditions. The rate of testing shall be as follows:
 - a. Two specimens for the first 50 splices (or fraction thereof) at the beginning of the job. Splices not meeting tension requirements shall be retested at Contractor's expense until all splices meet the tension requirements.
 - b. One specimen for every 100 (or fraction thereof) additional splices occurring on the job. Any splices not meeting tension requirements shall be retested at Contractors expense until all splices have passed the test.
 - c. A minimum of one test specimen shall also be selected from transition splices (splices of one bar size to another bar size), if any.
- C. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
 1. Reinforcing Steel: The Testing Laboratory or designated Special Inspector shall inspect 100% of reinforcement before each concrete pour to verify the information noted below. Inspection reports shall be prepared and distributed in accordance with the local building code and as specified in this specification.
 - a. Primary and secondary longitudinal reinforcement has correct size and number in proper layers.
 - b. Longitudinal reinforcement has correct length and lap.
 - c. Ties and stirrups are of correct size, spacing, and number and have the proper termination hook geometry.
 - d. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.
 - e. Proper hooks are provided at bar ends as detailed.
 - f. Reinforcement is properly supported and braced to formwork to prevent movement during concrete placement.
 - g. Reinforcement has proper cover.
 - h. Sufficient spacing between reinforcement for concrete placement.
 - i. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.
 - j. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped.

- k. Proper construction/control/expansion joint spacing and reinforcement.
- l. Reinforcement around embedded items is placed according to details.
- m. Welded reinforcement has been done according to AWS requirements.
- n. Proper installation of flat slab shear head reinforcement.
- o. Reinforcing Steel Compression Butt Splices: The Testing Laboratory shall provide 100% visual inspection of compression butt splices on the project. Inspection shall verify splice conformance with the requirements for end bearing splices as set forth in ACI 318 as well as the manufacturer's instructions.
- p. Mechanical Tension Splices: The Testing Laboratory shall provide 100% visual inspection of mechanical tension splices on the project and consult with the manufacturer regarding recommendations for installation. Inspection shall verify compliance with specifications and conformance with the manufacturer's recommendations for installation after consulting with the manufacturer, who is to be present for the first installation of the splice on the project.
- q. Welded Reinforcing: Continuous inspection of the welding of reinforcing bars to ensure compliance with the requirements of AWS shall be done for the following items:
 - 1) Reinforcing steel resisting flexural and axial forces.
 - 2) Boundary elements of reinforced concrete walls.
 - 3) Shear reinforcement.

3.04 CAST-IN-PLACE CONCRETE

- A. Quality Assurance:
 - 1. Concrete Mix Designs: The Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project.
 - 2. Preinstallation Meetings: The Testing Laboratory shall attend the preinstallation meetings as noted in Specification 033000 "Cast-in-Place Concrete."
- B. Source Inspection:
- C. Field Testing: The following tests shall be completed by the Testing Laboratory:
 - 1. During Concrete Placement:
 - a. Record the amount of water added and note if it exceeds the amount allowed to be added shown in the approved mix design.
 - b. Mold concrete test cylinders as specified below in Paragraph 3.a.
 - c. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment as specified below.
 - d. Record information for concrete test reports as specified below.
 - e. Pick up and transport to Laboratory cylinders cast the previous day.
 - 2. After Concrete Placement:
 - a. In-situ Concrete Strength Verification for Form Stripping: The Testing Laboratory shall perform the tests necessary to determine the concrete strength prior to form stripping:
 - 1) If concrete strength for form stripping is to be determined using field-cured cylinders, the cylinder shall be broken at the time of form removal as directed by the Contractor.
 - 2) If concrete strength for form stripping is to be determined using the Maturity Method, the Testing Laboratory shall verify that the requirements of ASTM C 1074 are being followed and that the proper criteria for determining concrete strength by this method has been established and is being followed.
 - b. Investigation of Low Strength Concrete Test Results:
 - 1) Cost of Investigations for Low Strength Concrete: The Contractor shall reimburse the Owner for the costs of investigations of low strength concrete, as defined in Part I above.
 - 2) Scope of Investigations: See Specification Section 03 30 00 "Cast-In-Place Concrete" for the investigations that may be required by the Engineer. The Testing Laboratory will conduct these investigations if required.

- c. Post-Installed Anchors in Concrete:
 - 1) Verify maximum anchor tightening torque for all applicable post-installed anchors.
 - 2) Provide pull tests on individual anchors as specified in the ICC Evaluation Services Report, on the drawings, or as directed by the Engineer-of-Record.
 - d. Floor Flatness and Levelness Measuring: Perform tests as defined below.
 - e. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering: Perform tests as defined below.
 - f. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:
 - 1) Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
 - 2) Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.
3. Standards for Concrete Tests:
- a. Concrete Test Cylinders: Mold and test concrete cylinders as described below:
 - 1) Cylinder Molding and Testing: Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Cylinders may be either 6" in diameter by 12" or 4" in diameter by 8", however, the diameter of the cylinder shall be at least three times the nominal maximum size of the coarse aggregate in the mix tested. All of the cylinders for each class of concrete shall be of the same dimension for all sets of that class.
 - 2) Field Samples: Field samples for strength tests shall be taken in accordance with ASTM C 172 at the point of placement.
 - 3) Quantity of Cylinders: Each set of test cylinders shall consist of a minimum of four standard test cylinders. If concrete strength for form stripping is to be determined using field-cured cylinders, one additional cylinder per set will be required for formed slab and pan-formed beam floors for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C 31. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test specimens. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.
 - 4) Frequency of Testing: A set of test cylinders shall be made according to the following minimum frequency guidelines:
 - (a) One set for each class of concrete taken not less than once a day.
 - (b) Piers, Piles, Underreamed Footings: One set for each 50 cubic yards or fraction thereof.
 - (c) Drilled/Underreamed Piers: One set for each 50 cubic yards or fraction thereof.
 - (d) Floors: One set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of floor area.
 - (e) Columns: One set for each 50 cubic yards or fraction thereof with a minimum of two sets per floor.
 - (f) All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof but not less than one set for each 5,000 square foot of area for walls.
 - (g) No more than one set of cylinders at a time shall be made from any single truck.

- (h) If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - (i) The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.
 - 5) The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.
 - 6) For concrete specified on the drawings to reach the required strength at 28 days, break one cylinder of the set at seven days, two 6" by 12" cylinders or three 4" by 8" cylinders at 28 days, and keep one in reserve for testing at the Engineer's direction.
 - 7) Cylinder Storage Box: The Contractor shall be responsible for providing a protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C 31.
 - 8) Transporting Cylinders: The Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.
 - 9) Information on Concrete Test Reports: The Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:
 - (a) Truck number and ticket number.
 - (b) Concrete Batch Plant.
 - (c) Mix design number.
 - (d) Accurate location of pour in the structure.
 - (e) Strength requirement.
 - (f) Date cylinders made and broken.
 - (g) Technician making cylinders.
 - (h) Concrete temperature at placing.
 - (i) Air temperature at point of placement in the structure.
 - (j) Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design.
 - (k) Slump.
 - (l) Unit weight.
 - (m) Air content.
 - (n) Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be brought to the attention of the Architect and Engineer in writing if either cylinder fails to meet specification requirements.
- b. Slump Tests: Slump Tests (ASTM C 143) shall be completed at the beginning of concrete placement for each batch plant and for each set of test cylinders made. The slump test shall be made from concrete taken from the end of the concrete truck chute. The concrete shall be considered acceptable if the slump is within the slump tolerance noted on the mix design submittal form for that class of concrete.
- c. Air Entrainment: Air entrainment tests (ASTM C 231 or C 173, C 173 only for lightweight concrete) shall be made at the same time slump tests are made as cited above. Samples for air entrainment tests shall be taken at the point of placement.

- d. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C 1064) at the same time slump tests are made as cited above.
- e. Floor Flatness and Levelness Measuring:
 - 1) The Testing Laboratory shall measure the floor for flatness and levelness according to ASTM E 1155.
 - 2) Measurement of the finished concrete surface profile for any test section shall be made when requested by the Representative at his option. Notwithstanding, measurements shall be made within 24 hours after completion of finishing operations. For structural elevated floors measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete.
 - 3) The concrete surface profile shall be measured using equipment manufactured for the purpose such as a Dipstick Floor Profiler as manufactured by the Edward W. Face Company in Norfolk, Virginia, F-Meters manufactured by Allen Face & Company in Norfolk, Virginia, optical, or laser means or other method specified in ASTM E 1155.
 - 4) Each floor test section and the overall floor area shall conform to the two- tiered measurement standard as specified herein.
 - (a) Minimum Local Value (MLV). The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable in any one floor test section.
 - (b) Specified Overall Value (SOV). The specified overall FF/FL values represent the minimum values acceptable for all combined floor test sections representing the overall floor.
 - 5) For purposes of this specification a floor test section is defined as the smaller of the following areas:
 - (a) The area bounded by column and/or wall lines.
 - (b) The area bounded by construction and/or control joint lines.
 - (c) Any combination of column lines and/or control joint lines.
 - (d) Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines as defined by ASTM E 1155.
 - (e) The precise layout of each test section shall be determined by the Testing Laboratory and shall be submitted for Architect/Engineer review and approval.
- f. Testing of Concrete Floor Slabs for Acceptability to Receive an Adhesive-Applied, Low-Permeable Floor Covering:
 - 1) The following tests shall be performed by the Testing Laboratory as a part of quality assurance testing to insure that the proper moisture condition and alkalinity of the substrate has been achieved prior to installing adhesive- applied, low-permeability floor coverings such as vinyl composition tile (VCT), linoleum, sheet vinyl, vinyl-backed carpet, rubber, athletic flooring, synthetic turf, wood, acrylic terrazzo, thin-set tile, epoxy overlays and adhesives, waterproofing, et.al.
 - (a) Moisture Vapor Emission Rate: Perform testing according to ASTM F 1869 to determine if the moisture emission rate from the floor is below the flooring manufacturer's maximum recommended value but not greater than five pounds per 1,000 square feet per 24 hours.
 - (b) Relative Humidity Determination Test: As an alternate to the Moisture Vapor Emission Rate Test, and if agreed to by the Contractor, Architect and Owner, perform testing according to ASTM F 2170 to determine if the relative humidity of the concrete slab is below the flooring manufacturer's maximum recommended value but not greater than 75%.
 - (c) Alkalinity Testing: Perform testing in accordance with ASTM F 710, Paragraph 5.3, to determine if the pH level of the concrete slab surface is

below the flooring manufacturer's maximum recommended value but not greater than 10. Perform one test per 1,000 square feet with a minimum of three tests within the total area being tested.

4. Evaluation and Acceptance of Concrete:
 - a. Strength Test: A strength test shall be defined as the average strength of two six inch cylinder breaks or three four inch cylinder breaks from each set of cylinders tested at the time indicated above.
 - b. Quality Control Charts and Logs: The Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:
 - 1) Number of strength tests made to date.
 - 2) Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
 - 3) Number of tests under specified strength.
 - 4) A histogram plotting the number of strength test cylinders versus compressive strength.
 - 5) Quality control chart plotting compressive strength test results for each test.
 - 6) Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
 - 7) Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.
 - c. Acceptance Criteria: The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
 - 1) The average of all sets of three consecutive strength tests equal or exceed the required f'_c .
 - 2) No individual strength test falls below the required f'_c by more than the greater of 10% of f'_c or 500 PSI.
 - d. If either of the above Acceptance Criteria requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.
- D. Field Inspection: The scope of the work to be performed by the inspector on the jobsite shall be as follows:
 1. Before Concrete Placement:
 - a. Inspect concrete formwork per Article 3.2.
 - b. Inspect concrete reinforcing per Article 3.3.
 - c. Inspect bolts and rods to be embedded in concrete for proper grade, size, length, and embedment.
 - d. For slabs-on-grade, verify that the moisture retarder is provided, is lapped properly, and is not torn or punctured.
 - e. Verify that there is no standing water in pour area and that all debris has been removed from the area and from the formwork.
 - f. Verify that openings and sleeves in slabs or walls are correct size and location. Verify that the openings are shown on the structural drawings and notify the Engineer immediately of any openings in the field that are not shown on the drawings.
 - g. Verify that horizontal and vertical sleeves through girders, beams, or joists have been approved by the Engineer and that approved reinforcement is provided.
 - h. Verify the tops of previously poured columns and/or walls are 1/2 inch below the deck soffit.
 2. During Concrete Placement: Provide continuous monitoring to:
 - a. Upon arrival of concrete, inspect the concrete to verify that the proper concrete mix number, type of concrete, concrete strength is being placed at the proper location. Verify that the mix meets the project specifications and is not over 90 minutes old at

- the time of placement. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
- b. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
 - c. Verify that the Contractor is following appropriate Hot Weather or Cold Weather concreting practices consistent with any extreme environmental conditions at the point of placement in the structure.
 - d. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
 - e. Verify that the formwork has remained stable during the concreting operation.
 - f. Verify that there are no cold joints.
 - g. Verify that the concrete is properly vibrated.
 - h. Inspect bolts embedded in concrete during concrete placement for verification that they have been properly installed to the specified embedment.
 - i. Verify that the finishing of the concrete surface is done according to specifications.
 - j. The Testing Laboratory shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.
3. After Concrete Placement:
 - a. Verify that the curing process is according to Specifications and that any curing compound used is applied in accordance with the manufacturer's recommendations.
 - b. Verify that sawcut control joints in slab-on-grades are cut within 12 hours of placement.
 - c. Post-Installed Anchors in Concrete: Provide inspection of post-installed anchor installations at the frequency noted in the specifications and in accordance with the published, currently valid, Evaluation Service Report (ESR) for each anchor product. Post-installed anchors include anchors and reinforcing steel. Inspection of post-installed anchors shall include but not be limited to the following:
 - 1) Periodic Inspection: Verify initial installation of post-installed anchors in concrete for each individual installer with each individual anchor product in accordance with the requirements stated below for each type of anchor. Periodically inspect anchor installation after the initial verification.
 - 2) Continuous Inspection: Verify each installation of post-installed anchors in concrete in accordance with the requirements stated below for each type of anchor.
 - 3) All Post-Installed Anchors: Verify that the anchor is installed in accordance with manufacturer's printed installation instructions as well as the following design requirements.
 - (a) Concrete type, concrete strength and concrete thickness are in accordance with design drawings.
 - (b) Anchor manufacturer and product, including material, is in accordance with design drawings or approved substitution.
 - (c) Anchor diameter, length and installed embedment depth.
 - (d) Drill bit type and diameter.
 - (e) Anchor edge distance and spacing.
 - (f) Hole diameter and depth.
 - (g) Hole cleaning procedure and cleanliness.
 - (h) Anchor maximum tightening torque.
 4. Adhesive Anchors: In addition to the requirements for All Post-Installed Anchors, verify adhesive identification and expiration date.

- a. The installation of all adhesive anchors shall be continuously inspected when anchors are subject to sustained tension loads, such as anchors for shelf angles, or when anchors are installed in an upwardly inclined condition.
- E. Causes for Rejection of Concrete: The Contractor shall reject concrete delivered to the site for any of the following reasons:
 1. Wrong class of concrete (incorrect mix design number).
 2. Environmental Conditions: Environmental condition limits shall be as follows unless appropriate provisions in concreting practices have been made for cold or hot weather:
 - a. Cold Weather: Air temperature must be 40°F and rising or the average daily temperature cannot have been lower than 40°F for 3 consecutive days unless the temperature rose above 50°F for at least one-half of any of those 24 hour periods.
 - b. Hot Weather: Environmental conditions must be such that cause an evaporation rate from the concrete surface of 0.2 lb./sq. ft./hr. or less as determined by Figure 2.1.5 in ACI 305R-91.
 3. Concrete may be placed at other environmental condition ranges only with approval of the job inspector for the Testing Laboratory or other duly appointed representative.
 4. Concrete with temperatures exceeding 95°F shall not be placed in the structure.
 5. Air contents outside the limits specified in the mix designs.
 6. Slumps outside the limits specified.
 7. Excessive Age: Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.
- F. Concrete Batch Trip Tickets: Concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. Tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.
- G. Field Inspection:
 1. Provide continuous inspection of shotcrete placement operations for proper application techniques and adherence to specification requirements.
- H. Reporting:
 1. Provide a daily written report of the day's activities including the disposition of any discrepancies in procedure or materials brought to the attention of the Contractor. Contact the Engineer and Architect by telephone and in writing in the event any reported discrepancy is not satisfactorily resolved.

3.05 STRUCTURAL STEEL

- A. Scope of Work:
 1. Contract Obligations:
 - a. Owner Responsibility: The Owner shall pay for initial shop and field inspections and tests as required during the fabrication and erection of the structural steel.
 - b. Testing Laboratory Responsibility: The inspection by the Testing Laboratory of the Fabricator's work shall be in sequence, timely, and performed in such a manner so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years of experience in structural steel testing and inspection. Refer to Paragraph 1.9B.4 for special requirements for welding inspectors. The Testing Laboratory shall provide test reports of inspections. All test reports shall indicate types and locations of defects found during inspection, the measures required and performed to correct such defects, statements of final approval of welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. Weld inspection reports shall be

signed by an inspector with current certification as an AWS Certified Welding Inspector (CWI). In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of the test reports.

- c. Rejection of Material or Workmanship: The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.
- B. Quality Assurance:
 - 1. Verify that the fabricator's fabrication and quality control procedures provide a sound basis for inspection control of workmanship and of the ability to conform to construction documents and industry standards. Review the procedures for completeness and adequacy relative to code requirements for the fabricator's finished product.
 - 2. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.
- C. Field Testing: The Testing Laboratory shall provide the following tests in the field:
 - 1. Test welds completed in the field according to Paragraph E "Weld Testing:" below.
 - 2. Test bolted connections completed in the field according to Paragraph I "High-Strength Bolt Testing."
 - 3. Perform bend tests on completed shear connectors attached to beams as required according to procedures outlined in AWS D1.1. In addition, perform field bend tests on an additional 2% of completed shear connectors on each beam but not less than one connector per beam.
 - 4. Testing of Non-Shrink Grout for Base Plates, Bearing Plates, and Precast Wall Panels:
 - a. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
 - b. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.
- D. Field Inspection: The Testing Laboratory shall provide the following inspections in the field:
 - 1. Inspect galvanized HSS and other cold-worked structural steel members for cracking or other damage resulting from galvanizing process. Endeavor to complete inspections prior to erection of these members. Immediately notify Contractor and Architect/Engineer of any irregularities discovered.
 - 2. Provide continuous or periodic monitoring of field welding as described below in Paragraph 0 "Weld Inspection and Process Monitoring."
 - 3. Provide continuous or periodic monitoring of field bolting as described below in Paragraph F "High-Strength Bolt Inspection and Process Monitoring" of high-strength bolt installation in pre-tensioned or slip-critical joints using turn-of-the-nut without matchmarking or calibrated wrench method of bolt installation.
 - 4. Inspect welded or bolted connections that were completed, but not inspected, in the shop. Perform inspections according to Paragraph 0 "Weld Inspection and Process Monitoring" and/or Paragraph F "High-Strength Bolt Inspection and Process Monitoring" as appropriate.
 - 5. Obtain the planned erection procedure, and review with the Erector's supervisory personnel.
 - 6. Check the installation of base plates for proper leveling, grout type, and grout application.
 - 7. Check structural steel as received in the field for possible shipping damage, workmanship, and identification marking to conform to AISC 360 for structural steel and specified ASTM standards for other steel.
 - 8. Verify that surveys are occurring as specified to check plumbness and frame alignment as erection progresses. Review the submitted survey report.

9. Periodically inspect the steel frame for such items as bracing and stiffening details, member locations, and joint details at each connection for compliance with approved construction documents.
10. Inspect 100% of the column compression and base joints for verification that gaps in contact bearing do not exceed 1/16 inch. Gaps greater than 1/16 inch but less than 1/4 inch shall be reported to the Owner and Engineer for assessment. All gaps greater than 1/4 inch shall be shimmed according to Specification 05 12 00 "Structural Steel Framing."
11. Endeavor to guard the Owner against the Contractor cutting, grinding, reaming, or making any other field modification to structural steel without the prior approval of the Engineer. Report any noted unauthorized modifications to the Owner and Engineer.
12. Approve Welding Procedure Specifications submitted by the Contractor. Approve any changes submitted by the Contractor to any WPS that has already been approved. Obtain the Welding Procedure Qualification Record (WPQR) for each successful WPS qualification.
13. Periodically verify welding electrodes to be used and other welding consumables as the job progresses.
14. Periodically observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders with sufficient frequency to assure compliance with code and contract document requirements. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
15. Continuously observe joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.
16. Periodically provide visual inspection of the root pass of partial and complete joint penetration welds.
17. Visually inspect 100 % of welds for proper size, length, location, and weld quality in accordance with AWS D1.1 requirements. Unless specifically noted otherwise, all welding shall be considered statically loaded nontubular connections.
18. Visually inspect 100% of completed shear connectors on each beam.
19. Visually inspect 100% of the welds of anchors to embedded plates that are to be cast into concrete elements.
20. In addition to the inspections above, perform the following:
 - a. Continuously monitor and observe joint preparation, assembly practice, welding techniques including preheating and sequence, and the performance of welders for 100% of complete and partial joint penetration welds, plug and slot welds, multiple-pass fillet welds, and single-pass fillet welds greater than 5/16 inch. Check preheating to assure conformance with AWS D1.1, Section 5.6. Verify procedure for control of distortion and shrinkage stresses.
 - b. Periodically monitor welding of single-pass fillet welds that are less than or equal to 5/16 inch.
 - c. Periodically monitor the welding of headed studs to floor beams.
 - d. Periodically monitor the welding of anchors to embedded plates that are to be cast into concrete elements.

E. Weld Testing:

1. Perform nondestructive examination services using a qualified technician with the necessary equipment to perform the following:
 - a. Nondestructive examination conducted in accordance with the specific requirements for the item being examined including radiographic (RT), ultrasonic (UT), magnetic particle (MT), or dye-penetrant inspection (PT). Nondestructive inspection procedures shall conform to AWS D1.1.
 - b. Interpret, record, and report results of the nondestructive tests.
 - c. Mark for repair, any area not meeting Specification requirements. Correction of rejected welds shall be made in accordance with AWS D1.1.

- d. Re-examine repair areas and interpret, record, and report the results of examinations of repair welds.
 - e. Verify that quality of welds meet the requirements of AWS D1.1.
 - 2. Fillet Welds: Provide the following:
 - a. MT test a minimum of 10% of the length of each fillet weld exceeding 5/16".
 - b. Periodic MT testing of representative fillet welds 5/16" and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
 - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
 - 3. Partial Joint Penetration (PJP) Welds, including Flare-Bevel Groove Welds: Provide the following:
 - a. MT test a minimum of 25% of the length of each PJP weld exceeding 5/16" effective throat.
 - b. Periodic MT testing of representative PJP welds 5/16" and less but need not exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
 - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
 - 4. Complete Joint Penetration (CJP) Welds: Provide the following:
 - a. All CJP welds exceeding 5/16" thickness shall be 100% UT tested per AWS D1.1 Clause 6 Part F. The Testing Laboratory shall review the CJP joints to determine where geometry or accessibility precludes the use of standard scanning patterns per AWS D1.1 Clause 6 Part F. At these locations the testing laboratory shall develop and submit for approval a written testing procedure in accordance with AWS D1.1 Annex S.
 - b. Periodic MT testing of representative CJP welds 5/16" and less not to exceed 10% of all such welds, except as required for high rejection rates as indicated in the following paragraph.
 - c. Increase MT testing rate for welders having a high rejection rate as required to ensure acceptable welds.
 - 5. Acceptance Criteria:
 - a. Visual, MT, PT shall be per AWS D1.1 Table 6.1.
 - b. UT testing shall be per AWS D1.1 6.13.1 and Table 6.2.
 - 6. Base metal thicker than 1.5 inches, where subjected to through-thickness weld shrinkage strains, shall be UT tested for discontinuities behind and adjacent to such welds. UT testing shall occur no sooner than 24 hours after the weld has cooled to ambient temperatures. Any material discontinuities shall be recorded on the basis of ASTM A 435 or ASTM A 898 (Level 1 criteria) and reported for Engineer disposition.
 - 7. Welds of Anchors to Embedded Plates:
 - a. Headed Studs: Perform field bend tests according to AWS D1.1 on 2% of the studs welded to plates, but not less than one stud per plate.
 - b. Deformed Bar Anchors: Perform MT testing on 10% of deformed bar anchors larger than #5 bar.
 - 8. The costs of repairing defective welds and the costs of retesting by the Testing Laboratory providing services for the Owner shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.
- F. High-Strength Bolt Inspection and Process Monitoring: The Testing Laboratory shall perform the following inspections for connections joined with high-strength bolts. Bolting performed in the shop may be inspected in the field unless continuous monitoring of the bolting operation is specified herein:

1. Observe preinstallation verification testing of the pretensioning method to be used in accordance with the requirements of the "Specification for Structural Joints Using High-Strength Bolts".
 2. Check daily the calibration of impact wrenches used in field bolted connections.
 3. Inspect bolt installation for 100% of high strength bolted connections according to inspection procedures outlined in the "Specification for Structural Joints Using High-Strength Bolts".
 4. Monitoring of Bolting Installation:
 - a. Continuous Monitoring: The Testing Laboratory shall be continuously present and monitor the bolting installation for compliance with the selected procedure for installation as specified in the "Specification for Structural Joints Using High-Strength Bolts" for joints using high-strength bolts that are designated on the plans as Pretensioned (PT) or Slip-Critical (SC) type joints and that are being installed using the calibrated wrench method or the turn-of-nut without matchmarking method of installation.
 - b. Periodic Monitoring: All other joint types and bolt installation methods shall be monitored on a periodic basis.
- G. High-Strength Bolt Testing: The Testing Laboratory shall perform the following tests for connections joined with high-strength bolts:
1. Perform Arbitration Testing according to procedures outlined in the "Specification for Structural Joints using High-Strength Bolts" when a disagreement exists between the Testing Laboratory and the Fabricator as to the minimum tension of installed bolts that have been inspected according to paragraph below.

3.06 STEEL DECKING

- A. Field Inspection:
1. Check steel deck as received in the field for possible shipping damage, workmanship, and identification marking to conform to specified ASTM standards for steel deck.
 2. Periodically monitor the method of attaching the steel floor and roof decking to the structural frame.
 3. Visually inspect 100% of the welding or other attachment method of steel deck to the structure and at sidelaps.

3.07 EARTHWORK

- A. Field Testing:
1. Compacted Fill:
 - a. Verification of Fill Material: Perform classification and testing to verify that the fill material to be used complies with the project specifications.
 - b. Field Density Testing: Perform field density testing as described below:
 - 1) Field density tests shall be run according to ASTM D 2937 or ASTM D 6938 as applicable.
 - 2) Acceptance Criteria: The results of field density tests by the Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not less than the required density with no single test falling more than 2 percent below the required density and the moisture content conforms to the requirements of the specification.
 - 3) Test Frequency for Paved Areas and Building Slab Subgrade:
 - (a) Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or building slab but in no case less than three tests.
 - (b) In each compacted fill layer or lift, make one field density test for every 2500 square feet of building slab or paved area but in no case less than three tests.
 - 4) Test Frequency for Foundation Wall Backfill: Make at least one field density test for each 200 lineal feet of wall with a minimum of 4 tests for the basement walls

around the perimeter of each building and a minimum of one test for every other type of foundation wall on the site. Tests shall be performed in random lifts along each wall.

- 5) Test Frequency for Compacted Fill beneath Column and Wall Footings: Make at least one field density test in each compacted fill layer or lift for each column footing, one for each twenty-five lineal feet of wall and one for each 2,500 square feet of mat foundation area or fraction thereof.
 - c. Report Copies: Moisture-density curves and results of field density tests shall be submitted to the parties specified earlier in this section.
 - d. Additional Testing: If reports by the Laboratory indicate field densities lower than specified, additional tests will be run by the Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be liable to the Owner for repayment by the Contractor.
2. Drilled Piers
 - a. Concrete Cylinders: Make and test concrete cylinders as specified for Cast-in-Place Concrete.
- B. Field Inspection by the Testing Laboratory:
 1. The Testing Laboratory shall provide inspection of materials used in foundation elements as described below.
 2. Compacted Fill:
 - a. Subgrade below Compacted Fill: Observe and verify that the subgrade below compacted fill has been properly prepared before compact fill construction begins.
 - b. During placement and compaction of fill, determine that the material being used and the maximum lift thickness comply with the specifications.
 3. Drilled Piers:
 - a. Reinforcing Steel: Inspect reinforcing steel size, number of bars, and placement and confirm dowel or anchor rod placement into footing.
- C. Foundation Inspection by the Geotechnical Engineer: The Geotechnical Engineer of Record shall provide inspection service for the following items before and during foundation installation as appropriate for the foundation type. The Geotechnical Engineer shall submit written field inspection reports promptly after inspection to the parties listed above and report his findings after each inspection by telephone or e-mail to the Engineer.
 1. Drilled Piers:
 - a. Subgrade: Verify that foundation bearing conditions are consistent with soil report tests and that the footing is being installed in the proper soil strata at the proper elevation. Make recommendations regarding adjustment to subgrade or bearing elevation if subgrade is not adequate to support footing.

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. Specific administrative and procedural minimum actions are specified in this Section, as extensions of provisions in other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication that such temporary activity is not required for successful completion of the Work and compliance with requirements of the Contract Documents. Provisions of this Section are applicable to, but are not limited to the temporary power, temporary water, temporary heat, field office, mobile telephone, sanitary facilities, storage facilities, signs, barriers, security, construction fence, cleaning, first aid facilities, fire protection, construction aids, parking facilities, storm water control and pollution prevention plan, as further expanded in this Section.

1.02 JOB CONDITIONS

- A. General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer required or when permanent facilities have, with authorized use, replaced their need.
- B. Conditions of Use:
 - 1. Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary, and protective of persons and property, and free of deleterious effects.
 - 2. Be responsible for overloading or excess use of or damage resulting from the overloading or excess use of existing utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials, not specifically described herein, but required for proper completion of Work of this Section, may be new or used as selected by the Contractor, but shall be of design, type, size, and strength recommended to suit intended purpose.
- B. Items required to protect the tenants, workmen, and public from danger, shall be sufficiently designed to protect them. Where required, exclude the public from all hazards.

PART 3 - EXECUTION

3.01 UTILITIES

- A. Temporary Power: Provide temporary power and all wiring, lamps, distribution of power, and equipment required for construction, inspection and testing of Work.
- B. Temporary Water: Provide temporary water and all hoses and equipment required for construction, inspection and testing of Work.
- C. Temporary Climate Control: Provide temporary climate control (heating, cooling and humidity control) required for construction of Work.
 - 1. Provide heat to prevent freezing and to avoid damage to materials in storage, during and after installation, and during curing and drying of materials and finishes. Provide and maintain such dependable source of supply of heat, cooling, and humidity control as necessary until the Work is accepted. No open fire heaters will be permitted. No mold, mildew, rust, or sagging materials due to humidity will be allowed. Contractor shall remediate any and all evidence of mold, mildew, or rust per applicable state standards and requirements.

3.02 FIELD OFFICE

- A. Furnish a job trailer installed at a suitable location on site for use by the Contractor and the Architect.
- B. Provide and maintain a weather tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, and the Owner and Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job telephone and other miscellaneous items as outlined below.
 1. Contractor's office shall be of a size, and furnished, so that it may be used for small progress meetings.
 2. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
 3. Provide direct line telephone service, for both voice communication and facsimile machines at Contractor's office and Owner/Architect's office.
 4. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
 5. Maintain a complete set of Construction Documents, Submittals, Record Documents, and other pertinent information for Contractor, Architect, Engineer, and Owner use.
 6. Furnishings Required:

3.03 MOBILE TELEPHONE

- A. Furnish and maintain a mobile telephone for his superintendent's use for the duration of the Project.

3.04 SANITARY FACILITIES

- A. Furnish and maintain temporary sanitary facilities. Comply with regulations of State Department of Health and other authorities having jurisdiction. The Contractor may not use the Owner's facilities.

3.05 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials can be stored within the structure in a weathertight condition.
- D. Provide for temporary freeze protection as needed.

3.06 SIGNS

- A. Furnish and install a project sign 6'-0" by 8'-0" in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
- B. Other signs permitted at the site:
 1. Warning signs.
 2. Directional signs.
 3. Identification signs at field offices.
 4. Emergency medical services sign.
 5. Signs required by Authorities Having Jurisdiction
 6. Storm Water Pollution Prevention Plan sign (SWPPP)
- C. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.

3.07 BARRIERS

- A. Provide temporary barricades on all portions of the site adjacent to the construction and accessible to the public.

3.08 TREE AND PLANT PROTECTION

- A. Locate and clearly flag existing trees, shrubs and other vegetation designated to remain or to be relocated. Protect and maintain in healthy condition.
- B. Provide approved barriers around trees and plants designated to remain to protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling, and continuous running water.
- C. Tree and Plant Protection: Install temporary fencing or other barriers located as indicated, or if not indicated, outside the drip line of trees, to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- D. Wood Enclosure Fence: Plywood, [6 feet] [8 feet] high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- E. Restoration and Replacement:
 1. Restore damaged vegetation to a condition as good as or better than its condition at commencement of operations under this Contract.
 2. Employ a licensed arborist to repair tree and shrub damage.
 3. Replace damaged trees that cannot be restored to full growth, as determined by arborist.

3.09 SECURITY

- A. Determine if and when watchmen are necessary for protection of the Work, and provide such services when necessary. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

3.10 CONSTRUCTION FENCE

- A. Provide a minimum 6 feet-0 inch high chain link construction fence around the perimeter of the construction area for the duration of the construction period. Said temporary construction fence shall have lockable access gates necessary to adequately access the site in order to execute the project. Access gates shall be locked at the completion of each day's work.

3.11 CLEANING

- A. Trash removal: Clear the building and site of trash at least once a week. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
- B. Disposition of Debris: Remove debris from site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- C. Final Cleaning: Thoroughly clean the Work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

3.12 TEMPORARY FIRST AID FACILITIES

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the field office telephone, listing the telephone numbers for emergency medical services: Physicians, ambulance services and hospitals.

3.13 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the Project and at specific areas of critical fire hazard.
- B. Equipment:
 - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
 - 2. Barrels of water with buckets designated for fire-control purposes.
 - 3. Water hoses connected to an adequate water pressure and supply system.
 - 4. Construction period use of permanent fire protection system.
- C. Enforce fire-safety discipline:
 - 1. Store volatile materials in an isolated, protected location.
 - 2. Avoid accumulations of flammable debris and waste in or about the Project.
 - 3. Prohibit smoking in the vicinity of hazardous conditions.
 - 4. Closely supervise and provide fire watches as required by authorities having jurisdiction during and after welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions.
 - 5. Supervise locations and operations of portable heating units and fuel.
- D. Contractor shall maintain fire-extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

3.14 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. Maintain all equipment in a first-class, safe condition.

3.15 PARKING FACILITIES

- A. Coordinate location of parking for personnel and employees at the facility to avoid interference with traffic, walks, work and storage areas, or with materials-handling equipment.
- B. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

3.16 STORM WATER CONTROL & POLLUTION PREVENTION PLAN

- A. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas. Refer to Civil Drawings for additional requirements.
- B. Provide and maintain a Storm Water Pollution Prevention Plan in accordance with Federal EPA requirements.
- C. File an EPA "Notice of Intent" Form with the EPA before construction begins.

END OF SECTION

SECTION 01 5500
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access roads.
- B. Parking.
- C. Existing pavements and parking areas.
- D. Permanent pavements and parking facilities.
- E. Construction parking controls.
- F. Maintenance.
- G. Removal, repair.
- H. Mud from site vehicles.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

3.02 ACCESS ROADS

- A. Use of designated & existing on-site streets and driveways for construction traffic is permitted.
- B. Tracked vehicles not allowed on paved areas.
- C. Provide unimpeded access for emergency vehicles. Maintain 20 foot (6 m) width driveways with turning space between and around combustible materials.
- D. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING

- A. Arrange for temporary parking areas to accommodate use of construction personnel.

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

- A. Prior to Substantial Completion the base for permanent roads and parking areas may be used for construction traffic.
- B. Prohibit traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

3.06 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing and new permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.07 REMOVAL, REPAIR

- A. Repair existing and new permanent facilities damaged by use, to original condition.
- B. Repair damage caused by installation.

3.08 MUD FROM SITE VEHICLES

- A. Provide means of removing excess mud from vehicle wheels before entering streets.

END OF SECTION

SECTION 01 5713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

1.03 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of State of Texas Erosion and Sedimentation Control Manual.
- C. Comply with all requirements of the project jurisdiction for erosion and sedimentation control .
- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Contractor will obtain permits and pay for securities required by authority having jurisdiction.
 - 2. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 3. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.

2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 10 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 1. Control movement of sediment and soil from temporary stockpiles of soil.
 2. Prevent development of ruts due to equipment and vehicular traffic.
 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.04 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 1. Submit within 2 weeks after Notice to Proceed.
 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 3. Obtain the approval of the Plan by authorities having jurisdiction.
 4. Obtain the approval of the Plan by Owner.

- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- B. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec⁻¹, minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force (450 N), minimum, in cross-machine direction; 124 pounds-force (550 N), minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 pounds-force (245 N), minimum, when tested in accordance with ASTM D4533/D4533M.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
 8. Manufacturers:
 - a. BP Amoco Fabrics and Fibers; www.geotextile.com.
 - b. TC Mirafi; www.tcmirafi.com.
 - c. Synthetic Industries; www.fixsoil.com.
- C. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).
- D. Gravel: See Section 32 1123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 1. Width: As required; 20 feet (7 m), minimum.
 2. Length: 50 feet (16 m), minimum.
 3. Provide at each construction entrance from public right-of-way.

4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart (at maximum of 60 m apart).
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet (30 m)..
 - b. Slope Between 2 and 5 Percent: 75 feet (23 m).
 - c. Slope Between 5 and 10 Percent: 50 feet (15 m).
 - d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
 - e. Slope Over 20 Percent: 15 feet (4.5 m).
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 1. Cover with polyethylene film, secured by placing soil on outer edges.
 2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 1. Excavate minimum of 6 inches (150 mm).
 2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
 3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.
- B. Silt Fences:
 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire

- reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
5. Install with top of fabric at nominal height and embedment as specified.
 6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches (50 mm) of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
 8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
 9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).
- C. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft (0.5 kg per 100 sq m).
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft (6 to 8 kg per 100 sq m).
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch (12 to 25 mm) deep.
 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Clean out temporary sediment control structures weekly and relocate soil on site.
- E. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Re-use of existing products.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 1101 - SUMMARY OF WORK: Lists of products to be removed from existing building.
- B. Section 01 2513 - PRODUCT SUBSTITUTION PROCEDURES: Substitutions made during procurement and/or construction phases.
- C. Section 01 4500 - QUALITY CONTROL: Product quality monitoring.

1.03 REFERENCE STANDARDS

- A. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc.; 2000.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 30 days after date of Notice to Proceed.
 - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
 - 1. Provide MSDS for all materials used on the project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
 - 3. Have longer documented life span under normal use.
 - 4. Result in less construction waste. See Section 01 7419
- D. Adhesives and Joint Sealants:
 - 1. Definition: This provision applies to gunnable, trowelable, and liquid-applied adhesives, sealants, and sealant primers used anywhere on the interior of the building inside the weather barrier, including duct sealers.
 - 2. Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
 - a. Require each installer to certify compliance and submit product data showing product content.
 - 3. Specific Product Categories: Comply with limitations specified elsewhere.
- E. Aerosol Adhesives:
 - 1. Provide only products having lower volatile organic compound (VOC) content than required by GreenSeal GS-36.
- F. Provide interchangeable components by the same manufacturer for components being replaced.
- G. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.
- H. Cord and Plug: Provide minimum 6 foot (2 m) cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, substitutions may be allowed at the Architects discretion based on overall value to the Owner.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.
- B. A request for substitution constitutes a representation that the submitter:
 - 1. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.

- C. 1 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 1101 - SUMMARY OF WORK for identification of Owner-supplied products.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- C. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 3. Handle, store, install and finish products.
 - 4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Cleaning and protection.
- E. Starting of systems and equipment.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - ADMINISTRATIVE REQUIREMENTS: Submittals procedures, Electronic document submittal service.
- B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- C. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- D. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
- E. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- F. Section 01 7900 - DEMONSTRATION AND TRAINING: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- G. Section 07 8400 - FIRESTOPPING.
- H. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.
 - 2. Limitations on cutting structural members.

1.03 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Alternatives to cutting and patching.
 - f. Effect on work of Owner or separate Contractor.
 - g. Written permission of affected separate Contractor.
 - h. Date and time work will be executed.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- G. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - PRODUCT REQUIREMENTS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.

- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 1. Review conditions of examination, preparation and installation procedures.
 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.
 8. Remove and replace defective and non-complying work.
- C. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work minimize damage and restore to specified condition.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- K. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- L. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.
- M. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.06 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - DEMONSTRATION AND TRAINING.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.10 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.
- J. Upon construction completion, clean and wax all new VCT floors per manufacturer's requirements, minimum 3 coats.

3.12 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 1. Provide copies to Architect.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.13 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 7329
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. Definition: "Cutting and Patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original undamaged condition, including original fire rating of fire rated construction.
 - 1. Cutting and patching is performed for coordination of the work for access or inspection, to obtain samples for testing, as indicated or required, to remove/replace defective work or work not conforming to the contract documents, to permit alterations to be performed, or for other similar purposes.
 - 2. Cutting and patching performed during the manufacture of products or during the initial fabrication, erection, or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".
- B. Refer to other Sections of these Specifications for specific cutting and patching requirements and limitations applicable to individual units of work.
 - 1. Unless otherwise specified, requirements of this Section also apply to mechanical and electrical work.

1.02 QUALITY ASSURANCE

- A. Visual requirements - Do not cut and patch work exposed on the building's exterior or in its occupied spaces, in a manner that would, in the Architect's opinion, result in lessening the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patchwork. Remove and repair or replace work judged by the Architect to be cut and patched in a visually unsatisfactory manner

1.03 RELATED WORK

- A. All Sections of Work requiring cutting and patching, including electrical requirements.

1.04 SUBMITTALS

- A. Procedural Proposal for Cutting and Patching - Where prior approval of cutting and patching is required, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal.
 - 1. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to existing work, including structural, operational, and visual changes as well as other significant elements.
 - 2. List products to be used and firms including their qualifications that will perform the work. Also, provide cost proposals when applicable.
 - 3. Give dates when work is expected to be performed.
 - 4. List utilities that will be disturbed or otherwise be affected by work, including those that will be relocated and those that will be disconnected or out-of service temporarily. Indicate how long utility service will be disrupted.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General - Except as otherwise indicated or as directed by Architect, use materials for cutting and patching that are identical to materials being cut and patched. If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials for cutting and patching that will result in equal or better performance characteristics.

1. The use of trade name and supplier's name and address is to indicate a possible source of the material or product. Product of the same type from other sources shall not be excluded provided they possess like physical and functional characteristics, except where specified as no substitutions allowed or where a material or product is specified as the basis of specification and no other approved manufacturers are listed.
2. Use materials, products, and devices to maintain integrity of fire rating of existing fire rated construction which comply with the requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before starting work, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.
 1. Before the start of cutting work, meet at the work site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work.
 2. After uncovering work, examine conditions affecting installation of product or performance of work.
 3. Report unsatisfactory or questionable conditions to Architect in writing; do not proceed with work until Architect has provided further instructions.

3.02 PREPARATION

- A. Provide temporary support to prevent failure of the work to be cut.
- B. Protect other work during cutting and patching to prevent damage. Provide protection from adverse weather conditions of that part of the Project that may be exposed during cutting and patching operations.
- C. Take precautions not to cut existing pipe, conduit, ducts, or wires serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

- A. General - Employ only skilled workmen to perform the cutting and patching work. Except as otherwise indicated or as approved by Architect, proceed with cutting and patching at the earliest feasible time and complete the work without delay.
- B. Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible, review proposed cutting and patching procedures with the original installer and comply with original installer's recommendations.
 1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or core drill to insure a neat hole. Cut holes and slots neatly to size required with minimum disturbance of adjacent work. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
 2. Comply with requirements of other applicable sections where cutting and patching requires excavating and backfilling.
 3. By-pass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated, or abandoned. Cut-off conduit and pipe in walls or partitions to be removed. After by-passing and cutting, cap, valve, or plug and seal tight remaining portion of conduit and pipe to prevent entrance of moisture, vermin, or other foreign matter.
- C. Patching - Patch with seams which are durable and as invisible as possible. Comply with specified tolerance, if any, for the work.
 1. Where feasible, inspect and test patched areas to demonstrate integrity of work.

2. Restore exposed finishes of patched areas and where necessary extend finish restoration into retained adjoining work in a manner which will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another finished area, patch and repair floor, wall, and ceiling surfaces in the new space to provide an even surface of uniform color and appearance. If necessary to achieve uniform color and appearance, remove existing floor and wall coverings or materials, and ceiling finish materials and replace with new materials.
 4. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.
 5. Patch, repair, or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
 6. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through non-fire-rated floors and walls, and through finished surfaces.
- D. Fire Rated Construction - Where cutting and patching is necessary in existing fire rated construction, use sealant and other fire resistive materials, products, and devices as required and acceptable by the authorities having jurisdiction to repair, patch, and otherwise restore original fire rating and integrity of construction.

3.04 CLEANING

- A. Thoroughly clean area and spaces where work is performed or used as access to work. Remove completely: paint, mortar, cement, oils, putty, sealant, and items of similar nature. Thoroughly clean piping, conduit, and similar features before painting or other finishes are applied. Restore damaged pipe covering to its original undamaged condition.

END OF SECTION

SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, incineration, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards (cubic meters).
 - c. Include weight tickets as evidence of quantity.
 - 7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

- D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 7700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 3119, Project Meetings.

1.02 SUBSTANTIAL COMPLETION

- A. The items listed in Document CB, Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be granted:
 1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
 2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.6 and 1.7.
 5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
 6. Testing and balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
 7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.03 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Format: Submit Operation and Maintenance Manual as annotated PDF electronic file.
- C. Submit preliminary Operations and Maintenance Manual to respective consultants (Civil, MEP, Structural, etc.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Contents: Prepare indexed Table of Contents with each product or system description identified, in three parts as follows:

- E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
- F. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - 1. Significant design criteria.
 - a. List of equipment.
 - 1) Parts list for each component.
 - (a) Equipment start-up instructions
 - (b) Operating instructions.
 - (c) Maintenance instructions for equipment and systems.
 - (d) Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - G. Part 3: Project documents and certificates, including the following:
 - 1. Product data.
 - a. Air and water balance reports.
 - 1) Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
 - b. Submit to Architect.
 - 2. PROJECT CLOSEOUT
 - a. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
 - 1) Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to Document CB, Supplementary Conditions, Paragraph 9.10 for additional information.
 - 2) Record Documents: Submit as described in paragraph 1.10.
 - 3) Extra materials: Provide extra stock, materials, and products as described in paragraph
 - 4) when required by individual specification sections.
 - 5) Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 6) Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
 - 7) Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
 - 8) Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.
 - 3. CLOSEOUT DOCUMENTS
 - a. Coordinate the following items with the requirements of Document CB, Supplementary Conditions of the Contract.
 - b. Prepare a bookmarked, indexed, searchable, electronic PDF file containing the following documents:
 - 1) Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
 - 2) Closeout Documents and Affidavits, include the following:
 - (a) AIA G707 - Consent of Surety to Final Payment;
 - (b) AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;

- (c) AIA G706A - Contractor's Affidavit of Release of Liens;
 - (d) Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached Close-out Form "A" - Affidavit of Subcontractor's Release of Lien.
 - 3) Project documents and certificates, including the following:
 - (a) Copy of Certificate of Substantial Completion (AIA G704);
 - (b) Copy of All Permits;
 - (c) Copy of Final Utility Bill or letter of transfer;
 - (d) Copy of Certificate of Occupancy;
 - (e) Certification of Project Compliance: Submit on attached Close-out Form "B". Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established;
 - (f) Hazardous Material Certificate: Submit on attached Close-out Form "C". Affidavits from Contractor, Subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project.
 - 4) Warranties, compile sequentially based on specification sections:
 - (a) General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
 - (b) Subcontractor's Warranty: notarized, and submitted on attached Close-out Form "D". This Warranty shall state all sections of Work performed by the subcontractor and warranty period;
 - 5) Receipts:
 - (a) Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below, (if applicable). Receipts must be signed by an authorized Owner's representative;
 - (b) Keys: Provide original receipts for delivery of "Keys", (if applicable). Receipts must be signed by an authorized Owner's representative.
 - c. In addition to the electronic files listed above, provide Owner with original paper copies of the following:
 - 1) Certificate of Occupancy.
 - 2) Manufacture's Special warranties.
 - d. Provide Architect with one (1) separate electronic file for their records containing the following:
 - 1) Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers;
 - 2) All MSDS sheets for the project;
 - 3) All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.
 - e. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.
4. FINAL CLEANING
- a. Execute final cleaning prior to final project inspection and acceptance.
 - (1)
 - b. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
 - c. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
 - d. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

- e. Clean and replace filters of operating equipment as required by Contract Documents
 - f. Clean debris from roofs, gutters, downspouts, and drainage systems.
 - g. Clean site; sweep paved areas, rake clean landscaped surfaces.
 - h. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.
5. **PROTECTING INSTALLED CONSTRUCTION**
- a. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.
 - b. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
 - c. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
 - d. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
 - e. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
 - f. Prohibit traffic from landscaped areas.
 - (1)
6. **STARTING OF SYSTEMS**
- a. Coordinate schedule for start-up of various equipment and systems.
 - b. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
 - c. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
 - d. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
 - e. Verify wiring and support components for equipment are complete and tested.
 - f. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
 - g. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
 - h. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.
7. **DEMONSTRATION AND INSTRUCTIONS**
- a. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
 - b. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
 - (1)
 - c. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
 - d. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
 - e. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
 - f. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.
 - g. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.

8. PROJECT RECORD DOCUMENTS
 - a. Submit Project Record Documents as described in Section 01 78 39 at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance of Record Documents by Architect and Engineers is achieved in accordance with the Owner's requirements.
 - b. At the Contractors request, and with associated fee, Architect may provide electronic versions of the BIM, construction drawings, and specification files for Contractor's use, subject to the terms and conditions of Architect's standard electronic document transfer agreement.
 - c. Submit semifinal Record Documents to the respective consultants (Civil, Structural, MEP, etc.) for review. Consultants will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
 - 1) Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.
9. EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS
 - a. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
 - b. Deliver to and store in location(s) as directed by Owner; obtain signed receipt(s) from Owner's authorized representative prior to final application for payment. Delivery of materials to or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.
 - c. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.
10. WARRANTIES, CERTIFICATES AND BONDS
 - a. Definitions:
 - 1) Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
 - 2) Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
 - b. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractors one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.
 - c. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.
 - d. In addition to the Contractors one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.
 - e. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
 - f. Warranty Requirements:
 - 1) When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

- 2) When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 - 3) Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 - 4) Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 5) The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- g. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to the Architect.
11. FINAL COMPLETION AND FINAL PAYMENT
 - a. Final Notice and Inspection:
 - 1) When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
 - 2) Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.
 - b. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
 - c. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
 - (1)
 - d. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.
 12. TERMINAL INSPECTION
 - a. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.
 - b. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
 - c. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 7839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Architects/Engineers written responses to Minor Change directives, Change Proposal Requests, and other supplemental instructions.
 5. Change Orders and other modifications to the Contract.
 6. Reviewed Shop Drawings, Product Data, and Samples.
 7. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner. Architect will review documents for general conformance but will not be responsible for completeness or accuracy of the recorded information.
- C. Do not use record documents for construction purposes. Store record documents separate from documents used for construction. Protect record documents from deterioration and loss in a secure, weather-tight location in accordance with Section 01 50 00, Temporary Facilities.
- D. Record information concurrent with construction progress, not less than weekly. Provide access to record documents for Architect's reference during normal working hours.
- E. Give particular attention to information on concealed products and installations that would be difficult to identify or measure and record later.
- F. Mark record sets in red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.
 1. Mark important additional information which was either shown schematically or omitted from original Documents.
 2. Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.
 3. Where feasible, the individual or entity who obtained record data, whether the individuals or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on record documents.
 - a. Accurately record information in an understandable drawing technique.
 - b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
 4. Sign or initial and date each mark-up.
- G. Upon completion of the Work, submit Project Record Documents to Architect for the Owner's records in accordance with Section 01 77 00, Closeout Procedures.
 1. Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.

1.02 RECORD DRAWINGS

- A. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Bookmarked, searchable, annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.

4. Architect and/or Engineers will furnish Contractor one set of digital data files of the Contract Drawings containing all CPR's, Clarifications, Minor Changes, and Architectural Supplemental Information for use in recording information.

1.03 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as bookmarked, searchable, annotated PDF electronic file.

1.04 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as bookmarked, searchable, annotated PDF electronic file.
 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.05 SHOP DRAWINGS

- A. Format: Submit record Shop Drawings as bookmarked, searchable, annotated PDF electronic file.
 1. Include record Shop Drawing directory organized by Specification Section number and title, electronically linked to each item of record Shop Drawing.

1.06 MISCELLANEOUS RECORD DOCUMENTS

- A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records, include, but are not limited to the following:
 1. Ambient and substrate condition tests.
 2. Changes requested by Owner's consultants.
 3. Inspections and certifications by governing authorities.
 4. Inspection and testing by Owner's inspection agency.
 5. Fire resistance and flame spread test results.

1.07 CERTIFICATION

- A. By submittal of Project Record Documents, Contractor certifies, that to the best of his knowledge, informational and belief the documents are a true and complete representation of the actual construction of the Work of this Project.

Texas Aggies Corps of Cadets
Association

202503

06-04-2025

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 7900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Conveying systems.
 - 6. Landscape irrigation.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 7700 - CLOSEOUT PROCEDURES: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 2. Submit to Commissioning Authority for review and inclusion in overall training plan.
 - 3. Submit not less than four weeks prior to start of training.
 - 4. Revise and resubmit until acceptable.
 - 5. Provide an overall schedule showing all training sessions.
 - 6. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.
 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
1. Identification of each training session, date, time, and duration.
 2. Sign-in sheet showing names and job titles of attendees.
 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
 4. Include Commissioning Authority's formal acceptance of training session.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Provide training in minimum two hour segments.
- C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 3. Typical uses of the O&M manuals.

- E. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

**SECTION 02 3200
GEOTECHNICAL INVESTIGATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Completed geotechnical report for Texas Aggies Corps of Cadets Association .

1.02 RELATED REQUIREMENTS

- A. Section 00 3100 - AVAILABLE PROJECT INFORMATION: Information regarding existing conditions of the site and existing buildings in or around which work is being performed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

***THE FOLLOWING PAGES CONTAIN THE GEOTECHNICAL INVESTIGATION REPORT FOR THE
ASSOCIATED PROJECT.***

END OF SECTION



April 28, 2025

Texas Aggie Corps of Cadets Association
1507 S College Avenue
Bryan, TX

Attn: Mr. Corey Keniston, Project Manager

Re: Report of Geotechnical Study for
TAMU CCA – Renovation and Addition
1507 S College Avenue
Bryan, Texas

Dear Mr. Keniston:

Dudley Engineering LLC (DUDLEY) is pleased to submit to you the accompanying report that documents the results of a geotechnical study performed for the proposed renovations and additions of the Texas Aggie Corps of Cadets Association (CCA) Headquarters in Bryan, Texas. The geotechnical study was performed in accordance with DUDLEY's Agreement dated March 26, 2025.

The accompanying report summarizes the results of the subsurface investigation and laboratory testing program. In addition, foundation and pavement design parameters are presented for the proposed development based on the results of the geotechnical study.

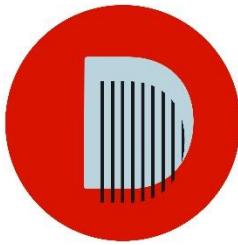
DUDLEY sincerely appreciates the opportunity to work with you on this project. Please do not hesitate to contact us at (979) 777-0720 if you have any questions or if we can provide any additional assistance. We look forward to continuing our working relationship with you in the future.

Sincerely,
Dudley Engineering, LLC

A handwritten signature in black ink that reads "G. Taylor Stinson". The signature is fluid and cursive, with a horizontal line underneath it.

G. Taylor Stinson, P.E.
Principal

Enclosures: Geotechnical Report
Via E-mail: [amitchell@comvest.net]



**REPORT OF GEOTECHNICAL STUDY
TAMU – RENOVATION & ADDITION
1507 S COLLEGE AVENUE
BRYAN, TEXAS**

Prepared For

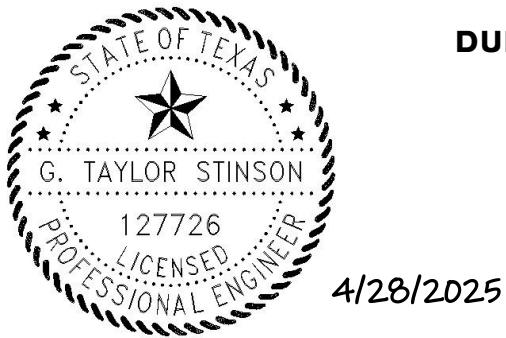
Texas Aggie Corps of Cadets Association
1507 S College Avenue
Bryan, TX

Prepared By

DUDLEY
40 Pamela Lane
College Station, TX 77845
Texas Engineering Firm Registration F-18677

DUDLEY Project No.: 25-00095

April 28, 2025



G. Taylor Stinson

G. Taylor Stinson, PE, MS
Principal

T. Kowshik Kumar

Kowshik Kumar, MS
Graduate Geotechnical Engineer



TABLE OF CONTENTS

1.0 INTRODUCTION	1
1.1 OVERVIEW	1
1.2 PROJECT DESCRIPTION.....	1
1.3 SCOPE OF SERVICES.....	1
2.0 SUBSURFACE INVESTIGATION.....	3
2.1 BORING DESIGNATION AND LOCATION	3
2.2 DRILLING AND SAMPLING	3
2.3 BORING LOGS.....	3
2.4 SAMPLE CUSTODY.....	4
3.0 LABORATORY TESTING PROGRAM	5
4.0 SITE CONDITIONS	6
4.1 SURFACE CONDITIONS.....	6
4.2 SUBSURFACE CONDITIONS.....	6
4.3 WATER LEVEL OBSERVATIONS	6
5.0 ANALYSIS	8
5.1 STRENGTH	8
5.2 VOLUMETRIC STABILITY	8
5.2.1 Moisture and Movement Active Zone.....	8
5.2.2 Shrink/Swell Potential	9
5.2.3 Site Improvement Techniques	9
5.3 SEISMIC LOADING CONDITIONS	10
6.0 FOUNDATION RECOMMENDATIONS	11
6.1 STORAGE BUILDING ADDITION.....	11
6.2 EXISTING STRUCTURE FOUNDATION SYSTEM.....	11
6.3 PROPOSED MONUMENT	12
7.0 FOUNDATION DESIGN PARAMETERS	13
7.1 GENERAL DESIGN PARAMETERS.....	13
7.2 SHRINK/SWELL DESIGN PARAMETERS.....	13
7.2.1 WRI Design Parameters.....	14
7.2.2 PTI Design Parameters	14
7.3 ARCHITECTURAL AND STRUCTURAL ELEMENT DETAILING	15
8.0 PAVEMENT RECOMMENDATIONS	17
8.1 ANTICIPATED TRAFFIC CONDITIONS.....	17
8.2 SUBGRADE SUPPORT	17
8.3 RIGID PAVEMENT THICKNESS REQUIREMENTS	18



8.4	FLEXIBLE PAVEMENT SECTION RECOMMENDATIONS.....	19
8.5	PAVEMENT MAINTENANCE.....	20
9.0	CONSTRUCTION CONSIDERATIONS	21
9.1	SITE PREPARATION.....	21
9.1.1	Demolition.....	21
9.1.2	Stripping and Clearing	21
9.1.3	Proof Rolling	21
9.2	BUILDING PAD DESIGN	22
9.3	FILL PLACEMENT REQUIREMENTS	22
9.4	SURFACE GRADING AND DRAINAGE	23
9.5	VEGETATION CONTROL AND CLEARING PRACTICES	24
9.6	SHALLOW FOUNDATION RECOMMENDATIONS	25
9.7	UTILITY TRENCH PROVISIONS	25
9.8	PAVEMENT SUBGRADE REQUIREMENTS	26
9.8.1	Chemical Stabilization.....	26
9.8.2	Omit Chemical Stabilization.....	27
9.9	RIGID PAVEMENT SECTION REQUIREMENTS	27
9.10	FLEXIBLE PAVEMENT SECTION REQUIREMENTS	27
10.0	BASIS OF RECOMMENDATIONS	29

LIST OF TABLES

Table 1.	Laboratory Classification Testing Procedures.....	5
Table 2.	Summary of Laboratory Classification Test Results.....	5
Table 3.	Seismic Design Parameters.....	10
Table 4.	Shallow Foundation Design Parameters	13
Table 5.	WRI Design Parameters.....	14
Table 6.	PTI Design Parameters.....	15
Table 7.	Rigid Pavement Thickness Recommendations	18
Table 8.	Flexible Pavement Thickness Requirements	19
Table 9.	Fill Requirements.....	22

LIST OF ATTACHMENTS

Attachment A Figures

Attachment B Boring Logs



1.0 INTRODUCTION

1.1 OVERVIEW

This report was prepared by Dudley Engineering LLC (DUDLEY) for Texas Aggie Corps of Cadets Association (CCA) to document the results of a geotechnical study performed for the proposed renovations and additions of TAMU CCA headquarters in Bryan, Texas. The geotechnical study was performed in accordance with DUDLEY's Agreement dated March 26, 2025. The Agreement was formally accepted on the same date.

The subsurface investigation was initiated on April 4, 2025 and was completed on the same day. The laboratory testing program was initiated shortly after the completion of drilling operations and was completed on April 7, 2025. A description of the subsurface information compiled during the field and laboratory phases of the project and an outline of DUDLEY's interpretation of the information is presented in this report for your review and consideration.

1.2 PROJECT DESCRIPTION

The proposed project will be located at 1507 S College Avenue as illustrated in Figure 1 in Attachment A of this report. The project will consist of a storage building addition, new paving, and a new monument. The proposed building addition will be one to two stories in height and will have a total footprint of approximately 1,116 square feet. The superstructure is anticipated to consist of structural steel or wood framing. The pavement areas are anticipated to be constructed using either a rigid or flexible pavement sections.

Grading plans are not currently available for the project. Nevertheless, we anticipate that changes in grade beneath the proposed storage building and paving will be on the order of 1 foot or less based on the improved nature of the site. DUDLEY should be notified if this is incorrect because it may result in changes to the recommendations presented in this report.

1.3 SCOPE OF SERVICES

The scope of services associated with the current geotechnical study included the following:



- **Task 1 – Subsurface Investigation:** Secure information on subsurface conditions at the project site by drilling two (2) exploratory borings.
- **Task 2 – Laboratory Testing Program:** Perform laboratory tests on select soil samples recovered from the borings to aid in characterizing the subsurface materials.
- **Task 3 – Engineering Analysis and Report Preparation:** Evaluate the information developed from the subsurface investigation and laboratory testing program so that geotechnical recommendations and design parameters can be furnished for the previously outlined project elements.



2.0 SUBSURFACE INVESTIGATION

2.1 BORING DESIGNATION AND LOCATION

Two (2) borings were drilled for the project. More specifically, one (1) boring was performed for the storage room addition and the other boring was performed for the paving and monument. The borings were designated as B-1 through B-2 as illustrated on Figure 2 in Attachment A of this report. The borings illustrated on Figure 2 were established by the drilling crew using a recreational hand-held global positioning system (GPS) device. The ground surface elevation at each boring was not specifically measured during drilling operations.

2.2 DRILLING AND SAMPLING

The borings were drilled with a Mobile B-57 track-mounted drilling rig. The borings were advanced dry with flight augers so that water levels could be monitored during and immediately after the completion of drilling operations. Soil samples were collected in accordance with either ASTM D1586 or ASTM D1587. Furthermore, SPT sampling utilized an automatic hammer, which generally has a higher energy transfer efficiency than traditional SPT equipment, i.e. safety hammers. The energy transfer ratio of the automatic hammer was not specifically evaluated as part of the current investigation; however, it is generally assumed to be 1.33 times more than that recorded using a standard safety hammer.

Both borings were advanced 15 feet below the existing ground surface. In total, 30 linear feet of drilling was associated with the project. Representative soil samples were obtained at 1.5- to 2-foot intervals within the upper 10 feet of the stratigraphy. Below a depth of 10 feet, samples were collected at 5-foot intervals to the termination depth of drilling.

2.3 BORING LOGS

The subsurface materials encountered at the borings were continuously logged in the field by a trained representative of DUDLEY. Following removal from the samplers, the soils were visually classified in accordance with ASTM D2488 – *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* and a color description was assigned using the Munsell Soil Color chart. Pocket penetrometer readings were also taken on cohesive



and cohesive-granular soil samples recovered from the borings to estimate strength. This information is summarized in Attachment B on the boring logs. A key to the terms and symbols used on the boring logs is also presented in Attachment B immediately after the boring logs.

The boring logs represent our present evaluation of the subsurface materials encountered at the project site based on observations and classification of the materials in the laboratory. The lines designating the interfaces between different soil types/formations are approximate and may be more gradual or more distinct. Variations will naturally occur and should be expected across the project site and between boring locations.

2.4 SAMPLE CUSTODY

Samples obtained as part of the subsurface investigation are and remain the property of Texas Aggie Corps of Cadets Association. Unless other arrangements are requested by the Texas Aggie Corps of Cadets Association and mutually accepted by DUDLEY in writing, DUDLEY will dispose of the samples ten (10) days after the date of this report. Samples consumed by laboratory testing procedures were discarded immediately after testing.



3.0 LABORATORY TESTING PROGRAM

The laboratory testing program was orientated in obtaining additional information on select soil samples recovered from the borings so that the soils could be classified in accordance with ASTM D2487 – *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*. The specific tests performed as part of the laboratory testing program, along with the number of each test, are summarized below in Table 1.

Table 1. Laboratory Classification Testing Procedures

ASTM Designation	Test Description	Number of Test Performed
ASTM D1140	Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing	7
ASTM D2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock Mass	7
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	7

The results of the laboratory tests are illustrated on the boring logs found in Attachment B of this report. In addition, the results are summarized below in Table 2. Soils that were not specifically tested in the laboratory were classified in accordance with ASTM D2488 – *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* and based on similarities with soil samples that were tested in the laboratory.

Table 2. Summary of Laboratory Classification Test Results

Range in Material Finer than No. 200 Sieve (%)	Range in Moisture Content (%)	Range in Liquid Limit (LL)	Range in Plastic Limit (PL)	Range in Plasticity Index (PI)
39.6 – 59.5	14.9 – 25.1	25 – 44	15 – 18	10 – 26



4.0 SITE CONDITIONS

4.1 SURFACE CONDITIONS

The project site is currently partially improved with an existing building and associated concrete paving. Area not specifically improved are vegetated by short grasses. There did not appear to be any obvious surface features, such as open bodies of water or drainage channels, within the project area during drilling operations or in readily available historic aerial photographs dating back to 1995 using Google Earth Pro (2025).

Existing paving was encountered at borings B-1 through B-2. The paving material consisted of concrete and the thickness was measured to range from 4.25 to 4.5 inches. The existing paving will have to be demolished as part of the proposed building addition and construction of new pavement associated with the project.

4.2 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the borings are presented in detail on the boring logs found in Attachment B of this report. The boring logs should be reviewed for a detailed description of the stratigraphy encountered at each boring. In general, the subsurface soils consisted of clays and sands. The sands were concentrated at boring B-1 and were classified as SC type soils (clayey sands) under the USCS. The relative density of the sands was estimated to range from loose to medium dense. The clays were concentrated at boring B-2 and were classified as CL type soils (low plasticity or lean clays) under the USCS. The consistency of the clays was estimated to range from stiff to hard.

4.3 WATER LEVEL OBSERVATIONS

Perched water or groundwater was encountered at both borings. The water levels were relatively consistent during and immediately after drilling and ranged from approximately 7 to 9 feet. The boreholes were subsequently backfilled with soil cuttings following the completion drilling and final water level measurements, and as such, long-term groundwater monitoring was not conducted as part of this investigation.



It should be noted that subsurface water levels can vary due to seasonal rainfall patterns, extended climatic shifts, and local site influences. Therefore, the presence or absence of water at the time of drilling does not ensure the same conditions will be present during construction or throughout the service life of the project.



5.0 ANALYSIS

Key considerations in the design of structures in this geographical area include: (1) the strength characteristics of the foundation soils, (2) the volumetric stability or potential shrink/swell movements of the foundation soils, and (3) seismic loading conditions for the project area. Each of these considerations is addressed in more detail in the following subsections based on the information compiled during the subsurface investigation and laboratory testing program.

5.1 STRENGTH

In general, the soils encountered at the boring locations exhibited enough strength to support the loads associated with the proposed storage room addition, paving and monument. Soils with Standard Penetration Test (SPT) values less than 5 are generally considered relatively weak. SPT values slightly above this threshold were observed near the ground surface at both borings and will likely be encountered at the time of construction. This is especially true if construction operations are initiated during or shortly after significant rainfall. If weak surficial soils are encountered at the time of construction, the soils should be removed from the building pad and paving areas prior to the placement of fill or foundation elements. However, under no circumstance shall more than 2 feet of existing soils be removed from a failed proof rolling area without first contacting DUDLEY for further evaluation and direction.

5.2 VOLUMETRIC STABILITY

5.2.1 Moisture and Movement Active Zone

The moisture active zone was estimated for the project site based on unsaturated soil mechanics and typical changes in climatic conditions for the Bryan, Texas area. Based on these considerations and the soils encountered at the boring locations, the moisture active zone was estimated to extend approximately 12 feet below the existing ground surface.

The design movement active zone is almost always shallower than the moisture active zone. Based on unsaturated soil mechanics and horizontal flow, the design movement active zone was estimated to extend approximately 6 feet below the existing ground surface.



Assumptions related to the estimated depth of the movement active zone include the following: (1) measures are taken to protect against ponding of water at the ground surface and lateral flow of water from on and off site and (2) protections must be implemented against accidental subsurface leaks, such as the lining of pressurized utility lines and an associated subsurface drainage system above the poly sheeting or the installation of devices to continuously monitor leaks and shut off water supply as needed. Failure to address these measures and/or protections could result in deep-seated swells below the estimated movement active zone and could result in volumetric movements greater than those estimated in the following subsections of this report.

5.2.2 Shrink/Swell Potential

Calculations were performed to estimate the magnitude of total potential swell movements in the subsurface soils based upon Texas Department of Transportation (TxDOT) Test Method Tex-124-E (Updated January 2017). Under this methodology, the magnitude of swell movement is referred to as potential vertical rise (PVR). Based upon the soils encountered in the estimated movement active zone, PVR was computed to be approximately **1.0 inches** or less for the dry-to-wet condition.

Calculations were also performed to estimate the magnitude of potential shrink/swell movements in the subsurface soils based upon the methodology outlined in the 3rd Edition of the Post-Tensioning Institute (PTI) publication entitled *Design of Post-Tensioned Slabs-on-Ground*. Under this methodology, potential unrestrained differential soil movements were estimated to be approximately **1.25 inches** or less for the post-construction conditions. The estimated movements can be reduced to approximately **1.0-inch** or less provided perimeter grade beams extend at least 2 feet below the adjacent ground surface established following the completion of construction.

5.2.3 Site Improvement Techniques

The excavation and replacement scheme is one (1) of the most effective site improvement techniques for reducing potential shrink/swell movements beneath a structure. However, preventative measures must be implemented to prevent water from infiltrating into the higher permeability select fill soils and migrating downward to clays present below the



estimated zone of seasonal moisture fluctuation and movement active zone. This site improvement technique involves the excavation or removal of a significant depth of volumetrically unstable clays from the upper portions of the stratigraphy and the replacement of the existing soils with select fill soils prone to low magnitudes of shrink/swell movements. However, it is DUDLEY's opinion that this scheme would not produce any notable reductions in volumetric movement based on the existing conditions encountered at the boring locations. As a result, stiffening the floor system to resist differential shrink/swell movements appears to be the most economical approach for the proposed storage building addition.

5.3 SEISMIC LOADING CONDITIONS

Based on the soils encountered at the boring locations and our experience with soils generally encountered in the upper 100 feet of the stratigraphy in this geographic area, Site Class D is recommended for the project site. Table 3 on the following page summarizes basic seismic design parameters that were determined based on the Site Class, the project location, and the provisions outlined in ASCE/SEI 7-16 – *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*.

Table 3. Seismic Design Parameters

Parameter	Description	Value
S_s	MCE _R ground motion (period = 0.2s)	0.082 g
S_1	MCE _R ground motion (period = 0.1s)	0.046 g
S_{DS}	Numeric seismic design value at 0.2s SA	0.073 g
S_{D1}	Numeric seismic design value at 0.1s SA	0.067 g



6.0 FOUNDATION RECOMMENDATIONS

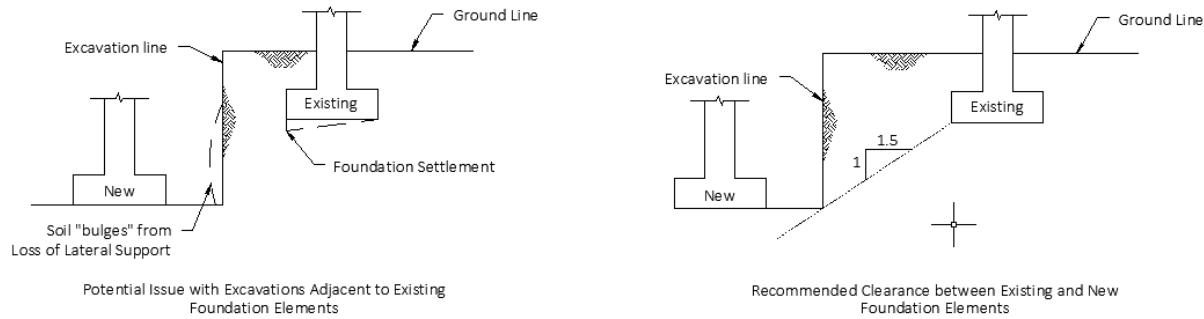
6.1 STORAGE BUILDING ADDITION

Based on the results of the subsurface investigation and laboratory testing program, it is DUDLEY's opinion that a subgrade supported floor system may be considered for foundation support of the proposed storage building addition. However, the floor system must be designed to resist differential volume change in the foundation soils and to prevent structural damage to the supported structure as outlined in the 2021 International Residential Code. The risk associated with this site would be considered **low** provided the floor system is stiffened in accordance with conventionally accepted design procedures.

For stiffened and reinforced, subgrade supported floor systems, the term risk is generally associated with cosmetic and maintenance related issues, including but not limited to, cracking in movement sensitive elements, doors and windows sticking, unlevel floor surfaces, etc. The level of risk also assumes that positive drainage and vegetation control will be established around the perimeter of the building as outlined in Section 9.

6.2 EXISTING STRUCTURE FOUNDATION SYSTEM

The current geotechnical study did not attempt to evaluate the foundation system for the existing storage building in detail. A detailed evaluation of the existing foundation system is recommended prior to construction. More specifically, the location and depth of existing foundation elements should be assessed. Excavations performed adjacent to the existing building could result in the excavation line soil bulging from loss of lateral support. This could also result in differential settlement and associated distress to the existing foundation system. Therefore, a minimum clearance of 1.5:1 horizontal to vertical (H:V) is recommended between the bottom of any existing footings and any new excavations associated with the installation of foundation elements or placement of compacted select fill. A very general example of this requirement is illustrated on the following page. If this is not feasible, deep foundation elements may have to be considered for the project.



Overlapping stresses of existing and proposed foundation elements may also have to be considered for the project. Once the existing foundation elements have been mapped and the location of the proposed foundation elements finalized, DUDLEY can provide additional guidance regarding overlapping stresses and potential reductions in allowable bearing pressure to minimize future total and differential settlement.

6.3 PROPOSED MONUMENT

The proposed monument is anticipated to consist of arches that are supported by columns with a relatively small footprint. Additional information is not currently available for the monument. Based on the results of the current geotechnical study, DUDLEY recommends that spread or continuous footings be used as foundation support for the monument structure.

The use of drilled pier foundation elements were also considered for the monument; however, relatively shallow groundwater levels were encountered at the two (2) borings during drilling. Therefore, the installation of drilled piers could be difficult and sloughing and/or caving could occur during this process. As a result, drilled piers are not specifically recommended for any of the proposed project elements.



7.0 FOUNDATION DESIGN PARAMETERS

7.1 GENERAL DESIGN PARAMETERS

Shallow foundation elements for the proposed building addition and monument should be designed to resist potential axial, uplift, and lateral loading conditions. Specific shallow foundation element design parameters for these loading conditions are provided below in Table 4 for shallow foundation elements founded in either existing on-site soils.

Table 4. Shallow Foundation Design Parameters

Minimum Founding Depth <small>Note 1</small>	24 inches below existing ground surface
Minimum Width	12 inches
Allowable Unit Base Resistance	1,500 psf (maximum loading, FS = 2.0)
	1,000 psf (sustained loading, FS = 3.0)
Estimated Footing Movement based on Sustained Loading	Maximum settlement: 1.0-inch or less
	Differential settlement: 0.75-inch or less
Lateral Sliding Resistance	Coefficient of friction – 0.30 (FS = 1.5)
Modulus of Subgrade Reaction for 1-ft by 1-ft Plate	100 psi/in (slab supported by on-site soils passing proof rolling observations or by compacted select fill)

Table 4 Notes:

1. Deeper founding depths may be required based on the design parameters furnished in Section 7.2.
2. The weight of the reinforced concrete footing (150 pcf) and the dead load acting on the footing may be considered when evaluating uplift resistance.

7.2 SHRINK/SWELL DESIGN PARAMETERS

As outlined in Section 1808.6 – *Design for expansive soils* of the 2021 International Building Code, moments, shears, and deflections for use in designing slab-on-ground, mat, or raft foundation supported by expansive soils shall be determined in accordance with WRI TF 700-R-07, PTI DC 10.5, or another rational design methodology. The following subsections provide geotechnical design parameters that can be utilized by the Structural Engineer for the WRI and PTI design methods. The recommended design parameters do not consider the



potential effects of non-climatic factors. These conditions include, but are not limited to, the location of trees and planters around the structure, poor drainage conditions and/or breaks in utility lines.

7.2.1 WRI Design Parameters

Design information related to the WRI design method for subgrade supported foundations is provided below in Table 5. The design parameters were formulated based on a climatic rating (C_w) of 20, which is representative of drought durations on the order of 2.5 months. Table 5 provides design parameters for existing conditions and variable thickness of select fill that may be placed as part of grading operations and/or site improvements techniques orientated toward the excavation and replacement scheme.

Table 5. WRI Design Parameters

Select Fill Building Pad Thickness	Effective Plasticity Index (PI)	Soil Climatic Rating (1 – C)
That required to achieve grading/drainage requirements or to replace weak on-site soils identified during initial proof rolling observations	20	0.05

Table 5 Notes:

1. The WRI/CRSI design procedure was formulated to limit deflections to L/480. The Structural Engineer should consider deeper beam depths and/or closer beam spacings than those computed using the WRI/CRSI procedure if stricter deflection criterion is required.

7.2.2 PTI Design Parameters

Design information related to the PTI design method for subgrade supported foundations is provided on the following page in Table 6.



Table 6. PTI Design Parameters

Select Fill Building Pad Thickness	e_m -center (feet)	e_m -edge (feet)	y_m -center (in)	y_m -edge (in)
That required to achieve grading/drainage requirements or to replace weak on-site soils identified during initial proof rolling observations	9.0	4.6	1.0	1.25

Table 6 Notes:

1. y_m values may be reduced by 20 percent if perimeter grade beams extend at least 2 feet below the adjacent ground surface.

A coefficient of friction of 0.75 is recommended for initial tendon stressing when the slab is cast directly on a polyethylene sheet. A coefficient of friction of 1.0 is recommended for initial tendon stressing when the slab is cast on a sand layer without a polyethylene sheet. Reference Table 4 for recommended coefficient of friction or adhesion when evaluating sliding due to environmental forces such as wind.

7.3 ARCHITECTURAL AND STRUCTURAL ELEMENT DETAILING

The superstructure and architectural elements of the proposed storage building shall be designed to accommodate the potential shrink/swell movements or consolidation of the foundation soils. Jointing of interior dry walls above door and window openings and the use of slip joints between dry wall panels should be considered. If movement-sensitive floor coverings, such as ceramic tile, marble, or wood, must be placed in the structure, we recommend that strong consideration be given to the use of geotextile reinforcement layers and/or underlayment layers between the floor coverings and the slab. Also, the tile should be frequently jointed to minimize the manifestation of distress cracking associated with slab movement. The use of flexible plumbing connections for water and sewer piping can help reduce, but not eliminate, potential leakage frequently associated with slab movements. Similarly, the employment of "through-slab" sleeves for rigid electrical conduit can help to minimize distress to the electrical system. Furthermore, all drainage piping and general plumbing piping systems associated with the building or in proximity to the building should be leak tested following installation. Water produced from any leaks in drainage or pressure piping following construction could produce localized swelling movements in the foundation



soils. The swelling movements may be of a greater magnitude than is typically associated with seasonal moisture variations as previously discussed in this report. These increased swelling movements could result in distress to foundation elements and the building superstructure.



8.0 PAVEMENT RECOMMENDATIONS

8.1 ANTICIPATED TRAFFIC CONDITIONS

Pavement recommendations have been formulated based on three (3) specific loading conditions, which include: (1) light-duty traffic loading, (2) light- to medium-duty traffic loading, and (3) medium-duty traffic loading. ***Light-duty traffic*** loading assumes passenger vehicles and up to five (5) single-unit trucks will utilize the pavement section daily. ***Light- to medium-duty traffic*** loading assumes 15 single-unit trucks (FHWA Class 4 through Class 7 vehicles) will utilize the pavement section daily. Finally, ***medium-duty traffic*** loading should be used for areas where concentrated vehicle loads, such as in dumpster pad areas, will be applied.

8.2 SUBGRADE SUPPORT

Following the completion of clearing, stripping, and grading operations, proof rolling shall be performed to verify that the exposed subgrade soils exhibit sufficient strength and stability prior to the placement of general fill and/or pavement layers. Based on the subsurface conditions at borings B-1 and B-2, the exposed subgrade soils are anticipated to consist of low plasticity clayey sands and sandy clays. Based on this consideration, we recommend that the upper 6 inches of exposed subgrade soils be chemically stabilized with Type I Portland cement. For preliminary planning purposes, four (4) percent cement by weight may be assumed for the project which correlates to 18 pounds per square yard of cement for a 6-inch-thick treated section.

In lieu of chemical stabilization, the upper 6-inches of exposed subgrade soils shall be scarified and compacted to at least 98 percent of the maximum dry density determined in accordance with ASTM D698. The moisture content of the compacted soil layer shall also be adjusted to within plus or minus 2 percentage points of the optimum moisture content (OMC) for soils with a less than or equal to 20 and within the OMC to 4 percentage points above the OMC, inclusive, for soils with a PI greater than 20.



8.3 RIGID PAVEMENT THICKNESS REQUIREMENTS

The minimum rigid pavement section thicknesses for each of the previously outlined traffic loading conditions are provided on the following page in Table 7 based on a 30-year design period.

Table 7. Rigid Pavement Thickness Recommendations

Traffic Loading Condition	Conventional Reinforced & Jointed Concrete Surface Course <small>Note 2</small>	Chemically Stabilized Subgrade Layer <small>Note 3</small>	Reinforcing Steel	Dowel Bar Requirements <small>Note 4</small>
Light-Duty	5 inches	6 inches	#3 @ 18" O.C.	¾" Diameter @ 12" O.C.
Medium-Duty	6 inches	6 inches	#3 @ 18" O.C.	¾" Diameter @ 12" O.C.
Heavy-Duty	7 inches	6 inches	#3 @ 18" O.C.	1" Diameter @ 12" O.C.

Table 7 Notes:

1. The design section for entrances to adjoining property driveways and tie-ins to intersecting city and state roadways may differ from those presented in the table and should be established based on applicable requirements.
2. Concrete assumed to have a minimum modulus of rupture (as determined in a third point beam loading test) corresponding to 530 psi (approximately equivalent to concrete with a 28-day compressive strength of 3,500 psi).
3. The requirements for compaction and chemical stabilization of the subgrade soils are presented in Section 8.2 and Section 9.
4. Dowel bars at expansion/construction joints shall be 18 inches long with a minimum embedment depth of 6 inches.

Adequate jointing of the concrete pavement should be included in the design and construction of the pavement sections. Concrete pavement should be segmented using control or contraction joints placed at a spacing that corresponds to approximately 24 to 36 times the slab thickness, with a maximum spacing of 18 feet regardless of the pavement thickness. Joint aspect ratios should be as close to 1:1 (square) as possible. The depth of the saw cut joints will depend on the type of method used to induce a plane of weakness. Conventional cutting methods are generally performed 12 to 24 hours after the concrete has been placed but should not be performed until the concrete has attained sufficient strength to resist spalling and raveling damage. The depth of a conventional saw cut is generally 1/4 to 1/3 times the thickness of the slab, i.e. 1.5 inches to 2 inches for a 6-inch thick concrete pavement



section. Early-entry saw cutting will generally be performed approximately 2 to 6 hours after the concrete has been placed and will depend heavily on temperature conditions. The early entry saw cuts should consist of a notch that is only 1.0 to 1.5 inches in depth. A saw cut joint thickness of 1/4-inch is recommended for both conventional and early-entry saw cut methods to provide a reservoir for sealant.

Keyed and doweled longitudinal joints should be in all pavement sections greater than one lane (10 to 13 feet) in width. Expansion joints should not be placed through the middle of area inlet boxes in the pavement. Isolation joints should be placed between the pavement and all existing or permanent structures (such as drainage inlets). All joints should be sealed with Sonneborn Sonolastic SL-1 (or equivalent) to minimize infiltration of surface water to the underlying subgrade soils.

8.4 FLEXIBLE PAVEMENT SECTION RECOMMENDATIONS

The minimum flexible pavement section thicknesses for each of the previously outlined traffic loading conditions are provided in Table 8 based on a 15 to 20-year design period.

Table 8. Flexible Pavement Thickness Requirements

Traffic Loading Condition	Hot-Mix Asphalt Concrete Surface Course (HMAC) <small>Note 1</small>	Flexible Crushed Rock Base Course <small>Note 2</small>	Stabilized Subgrade Layer <small>Note 3 and Note 4</small>
Light-Duty	2 inches	6 inches	6 inches
Light- to Medium-Duty	2.5 inches	8 inches	6 inches
Concentrated Load Areas	Not Recommended		

Table 8 Notes:

1. HMAC TxDOT Item 340 surface course, Type D.
2. Flexible crushed rock base course TxDOT Item 247, Grade 1-2, Type A or an approved equivalent.
3. The requirements for compaction and chemical stabilization of the subgrade soils are presented in Section 8.2 and Section 9.
4. Chemical stabilization can be omitted provided exposed subgrade soils are scarified and recompacted in accordance with the requirements outlined in Section 8.2. The aggregate base thickness shall be increased by 3-inches.



8.5 PAVEMENT MAINTENANCE

The control of surface and groundwater is a critical factor in the performance of a pavement system. Adequate surface and subsurface drainage provisions should be included in the pavement design scheme. Drainage provisions may include the following, among other items: a steeply graded pavement surface to quickly transport storm water to collection or discharge points; an adequate number of storm water catch basins or curb inlets in the paved areas to capture the storm water; and adequately sized storm water sewer piping or roadside drainage ditches. Finally, landscaping or “green” areas and other potential sources for moisture infiltration within the limits of adjacent parking areas should be minimized, if possible.

The owner should also institute and budget for a regular maintenance program for the paved areas. Regular pavement maintenance is a prerequisite for achieving acceptable performance levels over the anticipated life of the pavement system. Cracks occurring in the surface course of the pavement should be sealed as soon as they occur to minimize storm water infiltration into the underlying pavement system layers and subsequent degradation of performance. Sealants that can withstand exterior exposures, such as Sonneborn Sonolastic SL-1 PolySeal SL by Texas Polymer Systems for rigid pavements sections or rubberized asphalt sealants such as manufactured by Crafco for flexible pavement sections, should be considered for these purposes. A periodic inspection program should be conducted to identify the formation of cracks, eroded areas, and other indications of pavement distress, such as ruts, potholes, areas of ponded water, etc. The need for possible patching and overlaying of the pavement system should be anticipated over the expected life of the pavement.



9.0 CONSTRUCTION CONSIDERATIONS

9.1 SITE PREPARATION

9.1.1 Demolition

The contractor shall be responsible for coordinating all demolition and salvage all existing materials to perform the work. Demolition shall consist of the destruction and removal of all non-vegetative matter encountered above, on, or below the ground surface within the construction limits. This shall include, but not be limited to, buildings, abandoned utilities, all material derived from the demolition such as base course, curbs, curb and gutters, sidewalks, floors, steps, driveways, drainage structures of all sorts, guard fences, and other miscellaneous items such as foundations or walls of any sort, iron or steel items, and asphaltic items such as pavement and base courses. Materials shall be salvaged as indicated or specified, or disposed of in accordance with applicable federal, state, and local regulations and/or ordinances.

9.1.2 Stripping and Clearing

Any vegetation existing within the building area prior to construction shall be removed. In addition, any remaining organic matter and topsoil, as well as any weak, or wet soils, shall be stripped and removed from the building area. The removal of the vegetation should include all roots, including the major root systems associated with large trees, both currently existing as well as previously existing on the site. The removal of the major root systems should include any desiccated soils present within the root bulbs of the trees. If the existing vegetation and organic materials are not removed from the proposed building, it is possible that the existing vegetation will interfere with the proposed construction and could potentially adversely impact the future performance of the proposed structure.

9.1.3 Proof Rolling

Prior to placing any fill soils, proof rolling should be performed with a 15-ton pneumatic roller or equivalent vehicle to identify weak surficial soil formations. Any weak surficial soils identified during proof rolling should be removed and replaced with acceptable fill. For the



purposes of this report, weak soils are defined as soil exhibiting rutting deeper than 2 inches or elastic deformations greater than 1-inch during proof rolling observations.

9.2 BUILDING PAD DESIGN

Prior to placing any select fill soils, the exposed subgrade soils shall be scarified to a depth of 6 inches. The moisture content of the scarified soils shall be adjusted between -2 percentage points and +2 percentage points above the optimum moisture content (OMC), inclusive, and the soils shall be compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D698 (Standard Proctor).

9.3 FILL PLACEMENT REQUIREMENTS

Select fill used as part of the excavation and replacement scheme, to replace weak surficial soils, or to elevate the building pad above the existing ground surface to achieve drainage requirements should meet the material and compaction requirements outlined on the following page in Table 9. Alternatively, fill soils placed outside the building areas, within proposed paving areas, may consist of general site fill that meets the material and compaction requirements also outlined in Table 9 below.

Table 9. Fill Requirements

Fill Type	Plasticity Index (PI)	Compaction Standard	Dry Unit Weight <small>Note 1</small>	Moisture Content <small>Note 2</small>
Select Fill	8 to 20, inclusive	ASTM D698	$\geq 95\% D_A$	$W_{OPT} - 2\% \text{ to } W_{OPT} + 2\%, \text{ inclusive}$
General Site Fill	8 to 20, inclusive	ASTM D698	$\geq 95\% D_A$	$W_{OPT} - 2\% \text{ to } W_{OPT} + 2\%, \text{ inclusive}$
	21 to 35, inclusive	ASTM D698	$\geq 95\% D_A$	$W_{OPT} \text{ to } W_{OPT} + 4\%, \text{ inclusive}$

Table 9 Notes:

1. Maximum dry unit weight (D_A) determined in accordance with ASTM D698.
2. Optimum moisture content (W_{OPT}) determined in accordance with ASTM D698.

Compaction characteristics of the select fill shall be verified by in-place density tests. The tests should be performed on each 6-inch-thick lift at an average rate of one (1) test for every 2,000 square feet of plan area for the building pad and one (1) test for every 5,000 square



feet of plan area for the paving. A minimum of three (3) tests should be performed for each distinct lift of fill.

9.4 SURFACE GRADING AND DRAINAGE

Grading across the site and around the perimeter of the building is one of the most important factors in minimizing infiltration of surface water into the foundation soils. It is extremely important, particularly in areas where expansive soils are present, that water drains away from the foundation and not be allowed to pond against or near the foundation. Adequate slope of the ground surface is critical. The ground surface immediately adjacent to the building foundation shall be sloped away from the building at a slope of not less than 5 percent and, preferably more, for a minimum distance of 10 feet. In addition, small irregularities in the ground surface should be avoided over this 10-foot distance to prevent micro-ponding and subsequent surface water infiltration into the foundation soils. A slope of 2 percent is also recommended beyond this 10-foot distance. Impervious surfaces, such as flatwork or paving, within 10 feet of the building perimeter, should also be sloped not less than 2 percent. The minimum slopes are perpendicular to the perimeter of the foundation and not parallel to it. Slopes that are parallel to the foundation perimeter will distribute water along the foundation instead of removing it and result in surface water infiltration into the foundation soils. Finally, the slopes established on the site grading plan should consider maximum settlements outlined for the building foundation and any backfill placed adjacent to the foundation.

If physical obstructions or lot lines prohibit the 10-foot minimum horizontal distance, a 5 percent slope shall be established to an approved alternative method for diverting water away from the foundation. An approved alternative method would consist of a subsurface drainage system or swale. The subsurface drainage system or swale shall be sloped not less than 2 percent and must continue to divert water away from the foundation. The subsurface drainage system would generally consist of rigid perforated pipe, granular backfill, and a geotextile fabric or poly-liner. Furthermore, the subsurface drainage system would discharge into a sump, and area drain, or a suitable gravity outlet. If a sump is used, it must be equipped with a pump to drain water flowing into the sump. The pump should preferably discharge to an area-wide drainage system located well away from the foundation.



The roof drainage system, i.e. gutters and downspouts, serves to collect water from precipitation to carry it away from the foundation. The downspouts should be tight lined to extend at least 5 feet and, preferably 10 feet, beyond the perimeter of the foundation. This generally consist of connecting the downspouts to piping that will carry water to a sloping final grade at least 5 feet from the foundation or to an underground catchment system at least 10 feet from the foundation. This will reduce the chances of providing a supplemental source of water to the foundation soils and subsequent swelling movements.

9.5 VEGETATION CONTROL AND CLEARING PRACTICES

The effect of vegetation on expansive soil movement is dictated by the depth and extent of the root zone and the cracks in the soil that are generated by the growing roots. Trees and large vegetation near the foundation, either removed or planted during construction, cause most foundation problems requiring repair. Trees and large vegetation removed during construction tend to cause heave due to rehydration or increases in soil-moisture. This change in moisture generally occurs over a 5-year period, with approximately 50 percent of the moisture increase occurring over the first year of vegetation removal.

Trees planted within half of their mature height from the edge of the foundation have caused differential foundation movement because the root systems remove large quantities of water from the soil. If trees and large vegetation are planted near the foundation and if sufficient water is not supplied, the foundation soils may shrink resulting in subsidence in the foundation. Significant subsidence distress will usually not occur for 10 to 20 years as the tree matures. During dry periods, enough water should be supplied to trees to minimize shrinkage of expansive soils. Irrigation water should also be applied well away from the foundation to attract the tree roots in that direction. New trees and large vegetation should be planted away from the foundation. The rule of thumbs is that a tree should be at least 1 to 1.5 times its mature height away from the foundation. If trees are planted well away from the foundation in irrigated areas, the chances of subsequent foundation damage will be minimized.

On expansive soils, the main landscaping goal should be to minimize fluctuations in soil water content. Proper surface drainage, plant choices, sprinkling practices, and long-term maintenance are all important. Landscaping practices will have a significant influence on the wetting of the foundation soils. Xeriscape landscaping or landscaping requiring little or no



irrigation should be considered within the first 5 to 10 feet of the foundation perimeter. This will eliminate the need for supplemental water from irrigation. Furthermore, sprinkler systems should be directed away from the foundation and should not spray water within 5 feet of the foundation. Landscaping practices must also be careful to maintain positive drainage away from the foundation. Watering should be limited to the minimum needed to maintain the landscaping. Furthermore, landscaping should not trap water against the foundation. Metal edging or other damming devices within 5 feet of the foundation should be avoided.

9.6 SHALLOW FOUNDATION RECOMMENDATIONS

DUDLEY strongly recommends the prompt placement of concrete into the footing excavations immediately following completion of digging, cleaning, placement of reinforcing steel, and inspection of the excavation. Precautions should be taken during placement of the reinforcement and concrete to prevent any loose excavated soil from entering the excavation. Any clods of earth that slump into the footing excavation during concrete placement should be promptly removed. DUDLEY should also be contacted if the shallow foundation excavations become impacted by rainfall events that result in weak layers at the base of the excavations.

9.7 UTILITY TRENCH PROVISIONS

The following considerations should be included in the planning of utility installation at the site:

- Excavation and shoring requirements for all open excavations should be performed in accordance with applicable provisions of OSHA 29 CFR 1926.
- Soils used to backfill utility trenches shall be free of deleterious material and excessive amounts of silt. Native soils or soils meeting structural fill requirements may be used for backfilling of utility trenches unless otherwise prohibited by project plans and specifications.
- Trench backfill shall be placed in loose lifts not to exceed 8 inches and mechanically compacted to the required moisture/density specifications.
- Soils used to backfill utilities located beneath structure, paved surfaces, or other structural units shall meet the previously outlined material characteristics and shall be compacted to at least 95 percent of the maximum dry density as determined by the previously referenced standard Proctor compaction test, ASTM D698. Alternately, cement-stabilized sand may be used for utility backfill in areas planned for pavement placements.



- Utility lines shall be lined if preventative measures are desired to minimize underlying heave due to breaks and/or leaks in water bearing utilities.

Provisions should be made to discourage the possibility that utility trenches will serve as pathways for water to migrate from areas outside of the structure area to beneath the structure following completion of construction. We recommend that the bottom of the utility trenches be sloped in a downward direction away from the structure. We also recommend that anti-seep collars be employed along the length of all utility trenches and at the face of the structure to serve as a barrier to moisture migration along the granular soils in the trenches to the interior portions of the structure.

9.8 PAVEMENT SUBGRADE REQUIREMENTS

9.8.1 Chemical Stabilization

The specifications for chemical stabilization of the subgrade soils are presented in the following “bulleted” list.

- The minimum depth of chemical stabilization must be 6 inches. Overmixing of the chemical admixture is heavily discouraged unless additional quantities of stabilizing agents are furnished to account for the overmixing to produce the required percentage of chemical admixture.
- The stabilized layer should extend at least 2 feet beyond the back of the curb or the edge of the pavement. This extension of the stabilized area will assist in the formation of a moisture barrier and will help reduce moisture fluctuations in the underlying expansive soils along the edges of the pavement system.
- Compaction of cement stabilized soils should be at moisture contents within the range of plus or minus 2 percentage points of optimum moisture content OMC, inclusive. The compacted density of the lime stabilized subgrade soils should be at least 98 percent of the maximum dry density as determined by the previously referenced Standard Proctor compaction test, ASTM D698.
- 4 percent cement may be assumed, which corresponds to 18 pounds per square yard for 6-inch thick chemically treated section.
- Compaction characteristics of the chemically stabilized pavement subgrade layer should be verified by in-place density tests. At a minimum, the field tests should be performed at an average rate of one test for every 5,000 square feet of pavement area.



9.8.2 Omit Chemical Stabilization

In the absence of chemical stabilization, the exposed subgrade soils shall pass proof rolling observations. The exposed soils should then be scarified to a minimum depth of 6 inches, the moisture content of the soils adjusted as necessary, and the soils compacted to at least between 98 percent of the maximum density determined by the Standard Proctor compaction test (ASTM D698). The moisture content of the compacted soil layer shall also be adjusted to within plus or minus 2 percentage points of the optimum moisture content (OMC) for soils with a plasticity index less than or equal to 20 and within the OMC to 4 percentage points above the OMC, inclusive, for soils with a plasticity index greater than 20.

9.9 RIGID PAVEMENT SECTION REQUIREMENTS

The rigid pavement surface course should have the following strength and material properties.

- The PCC surface course should have a maximum water/cement ratio of 0.50. The concrete should also have a minimum modulus of rupture of 530 psi (as determined using a third point beam loading test, ASTM C78-08 – *Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)*), which corresponds to a minimum 28-day compressive strength of 3,500 psi. For this project, compressive strength testing can be utilized as opposed to the third point beam loading test.
- An adequate amount of air entrainment should be included in the PCC wearing surface.

9.10 FLEXIBLE PAVEMENT SECTION REQUIREMENTS

The flexible pavement section layers should comply with the material requirements of the Texas Department of Transportation's *Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges* (SSCMHSB). More specifically, the following pavement material types and properties are recommended for a flexible pavement section.

- The base course in the flexible pavement section should consist of crushed limestone aggregate base that meets or exceeds the requirements of SSCMHSB Item 247 – Flexible Base, Grade 1-2. The base shall be compacted



to at least 95 percent of the maximum dry density determined by Tex-113-E. Maintain moisture during compaction within plus or minus 2 percentage points of the OMC, inclusive.

- The HMAC surface course should comply with SSCMHSTB Item 340 – Dense-Graded, Hot Mix Asphalt (Method), Type D as called for.



10.0 BASIS OF RECOMMENDATIONS

The subsurface information at the site was developed from the subsurface investigation and laboratory testing program and was based upon two (2) widely spaced borings across the project site. The borings were in enough detail and scope to form a reasonable basis for the conceptual planning and design of the foundation system for the proposed building described in this report. Recommendations contained in this report were developed based upon a generalization of the subsurface conditions encountered at the boring locations across the site and the assumption that the generalized conditions are continuous throughout the areas under consideration. However, regardless of the thoroughness of a subsurface exploration, there is always a possibility that subsurface conditions encountered over a given area will be different from those present at specific, isolated boring locations. As a result, actual site conditions may be better or worse than the conditions indicated at the boring locations.

DUDLEY warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional engineering practice in the field of geotechnical engineering in this geographic area. No other warranty is implied or expressed.

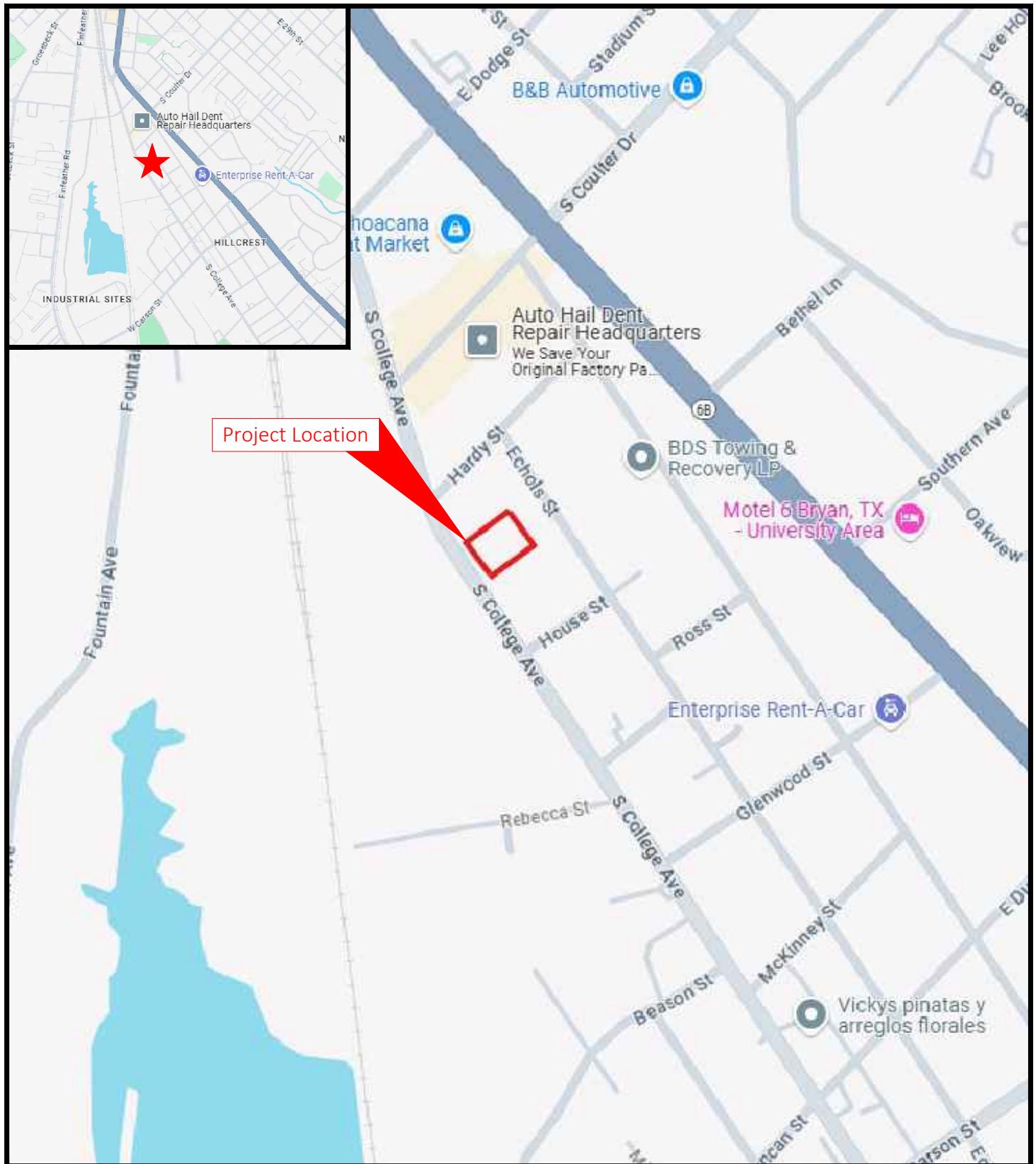
The information presented in this report was presented for the specific site and the specific structure described in the report. The information should not be employed for the design of other structures or for other projects in the general area of this project without the written consent of DUDLEY.



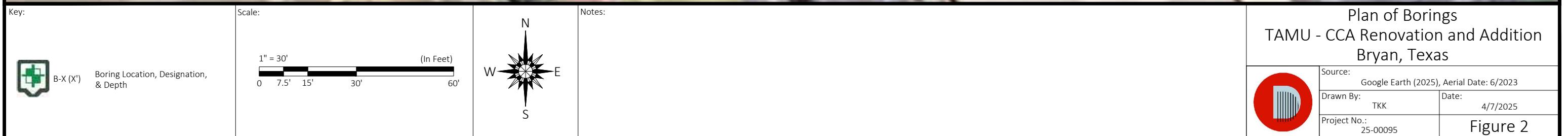
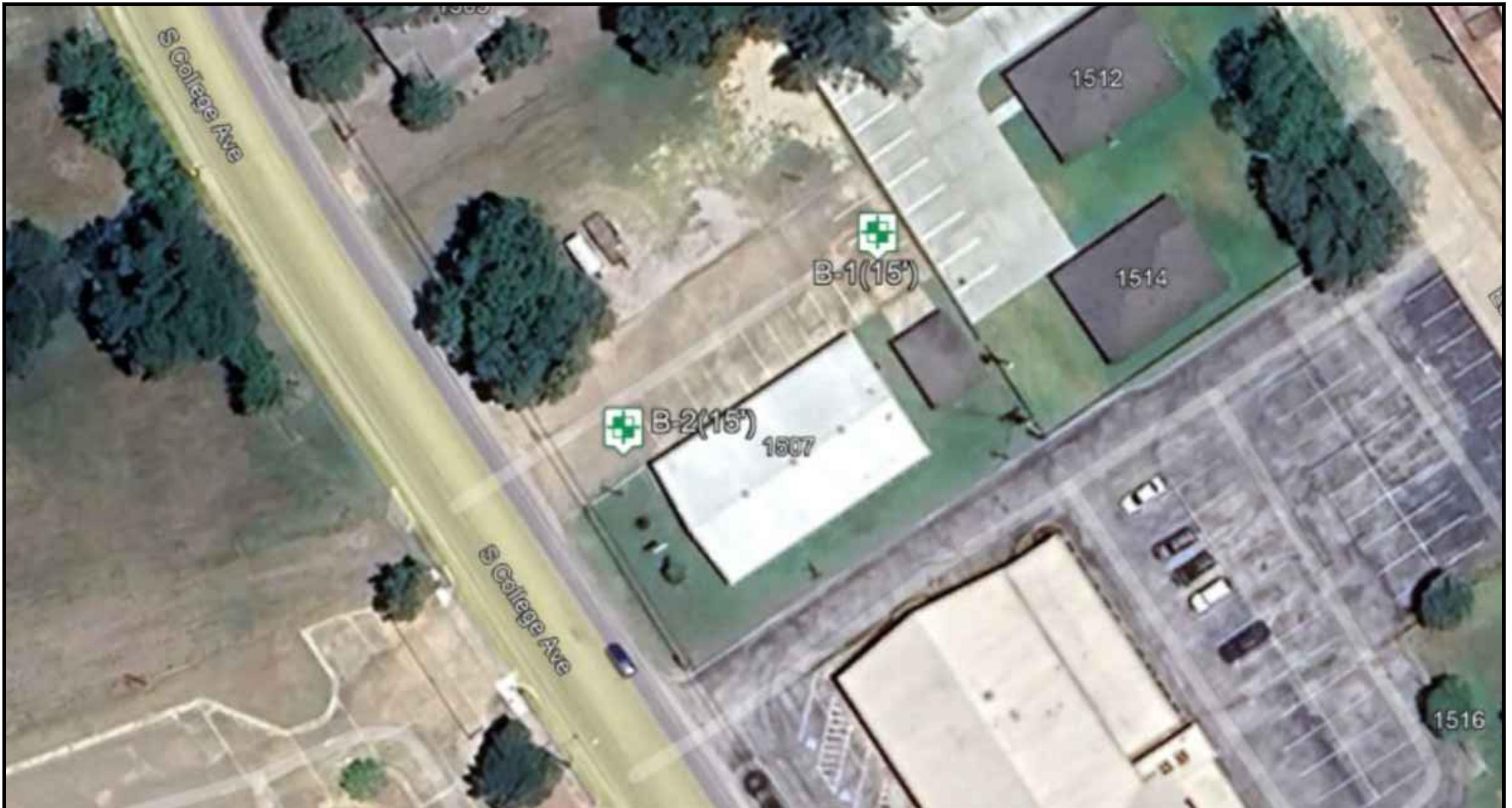
ATTACHMENT A

Figures

- Figure 1 – Vicinity Map
- Figure 2 – Plan of Borings



	Vicinity Map				
	TAMU CCA - Renovation and Addition				
	Bryan, Texas				
Source:	Google Maps (2025)	Drawn By:	TKK	Date:	4/7/2025
				Project No.:	25-00095
					Figure 1





ATTACHMENT B

Boring Logs
Log of Borings B-1 and B-2
Boring Log Key



LOG OF BORING

TAMU CCA - Renovation and Addition
1507 S College Avenue
Bryan, TX

Project No.: 25-00095

Page 1 of 1

Location:

B-1

Drill Date:

4/2/2025

Surface Elevation:

Unknown

MATERIAL DESCRIPTION

Depth (ft)	Sample	USCS Abbreviation	Water Level	Material Description	Field Strength Data				Moisture Content (%)	Atterberg Limits			Gradation (%)			Natural Moisture Content & Atterberg Limits	Add'l Laboratory Tests & Remarks
					PP Reading (tsf)	SPT N-Value (blows/ft)	TCP N-Value (blows/ft)	PP Reading (tsf)		1.0	2.0	3.0	4.0	1.0	2.0	3.0	
0				Pavement - 4.25 inch CONCRETE pavement. Loose, dark gray, clayey SAND, slightly moist					17.6	28	15	13					
2.5	SC			-brown between 2' - 4'		6		▲	18.1	26	15	11					
5	SC			-medium dense and orangish-dark gray below 4'		6		▲	17.6	35	17	18					
6				-gray below 6'		2.5	8	●	25.1	44	18	26					
8						10		▲									
10	SC					2.5	10	▲									
12						3.0	8	●									
15				Boring terminated at 15'													

Sample Key: Split-Spoon (SPT)

Shelby Tube

Texas Cone

Disturbed

No Recovery

Water Level Symbols: During Drilling After Drilling

Water Level During Drilling (ft): 8.5

Water Level After Drilling (ft): 6.9

Notes:

1. Borehole drilled with Mobile B-57.
2. Drilling Method: Flight Auger.
3. SPT - Automatic hammer.



LOG OF BORING

TAMU CCA - Renovation and Addition
1507 S College Avenue
Bryan, TX

Project No.: 25-00095

Page 1 of 1

B-2

— 1 —

4/2/2025

4/2/2025

MATERIAL DESCRIPTION

Sample Key:	<input checked="" type="checkbox"/> Split-Spoon (SPT)	<input type="checkbox"/> Shelby Tube	<input type="checkbox"/> Texas Cone
	<input checked="" type="checkbox"/> Disturbed	<input type="checkbox"/> No Recovery	

Water Level Symbols:  During Drilling  After Drilling

Water Level During Drilling (ft): 8.6

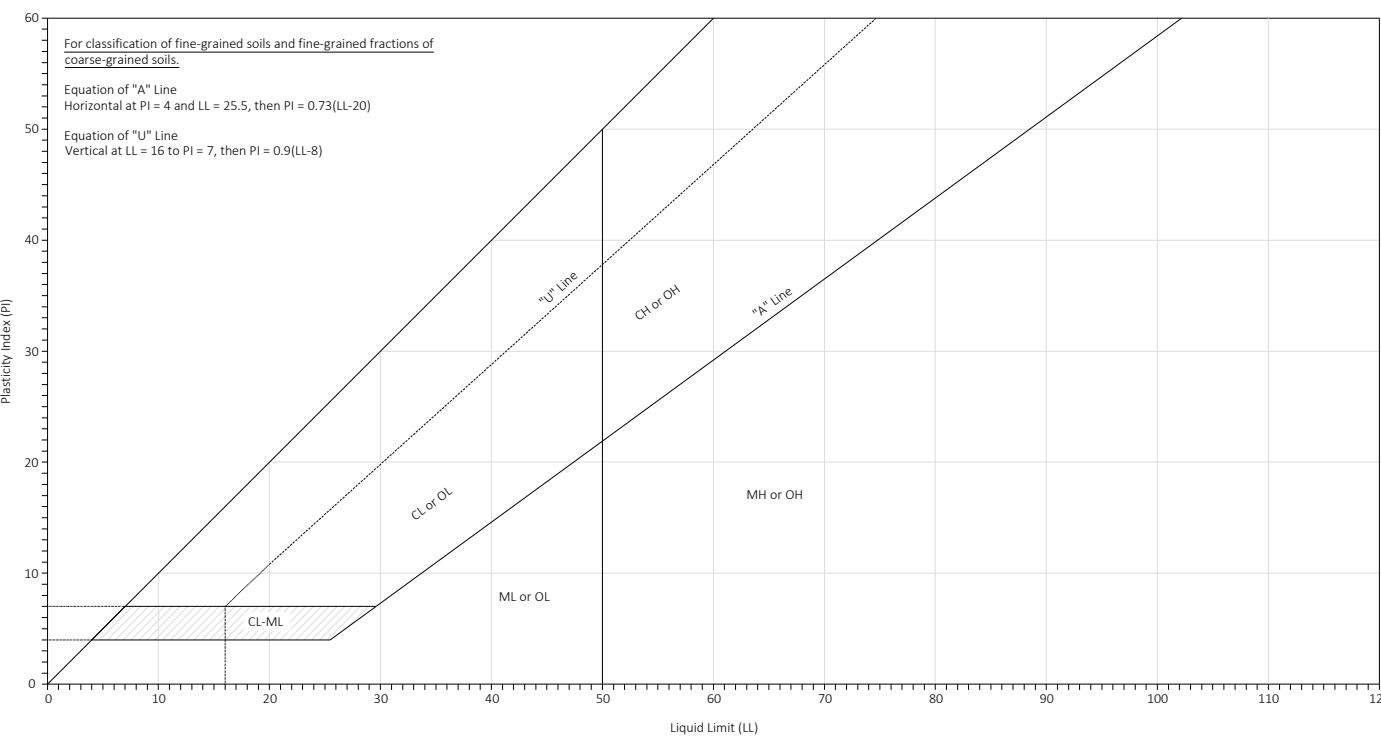
Water Level After Drilling (ft): 8.6

Notes

1. Borehole drilled with Mobile B-57
 2. Drilling Method: Flight Auger.
 3. SPT - Automatic hammer.

BORING LOG KEY (SHEET 1 OF 2)

Major Classification Group	Sub-Group		Group Hatch	Group Symbol	Group Name	Laboratory Classification Criteria			
Coarse-Grained Soils (> 50% retained on the #200 sieve)	Gravels (> 50% of the coarse fraction is retained on the #4 sieve)	Clean gravels		GW	Well-graded gravel	$C_u \geq 4$ and $1 \leq C_c \leq 3$			
				GP	Poorly-graded gravel	$C_u < 4$ and/or $1 < C_c$ or $C_c > 3$			
		Gravels with fines		GM	Silty gravel	Fine classify as ML or MH			
				GC	Clayey gravel	Fine classify as CL or CH			
	Sands (≥ 50% of the coarse fraction passes the #4 sieve)	Clean sands		SW	Well-graded sand	$C_u \geq 6$ and $1 \leq C_c \leq 3$			
				SP	Poorly graded sand	$C_u < 6$ and/or $1 < C_c$ or $C_c > 3$			
		Sands with fines		SM	Silty sand	Fine classify as ML or MH			
				SC	Clayey sand	Fine classify as CL or CH			
	Silts and clays with liquid limit < 50%			CL	Low plasticity or lean clay	PI > 7 and plots on or above "A" line (Must fall outside CL-ML hatched area)			
				ML	Low plasticity silt	PI < 4 and plots below "A" line (Must fall outside CL-ML hatched area)			
				OL	Low plasticity organic silt or clay	LL ratio < 0.75			
				CH	High plasticity or fat clay	PI plots on or above "A" line			
	Silts and clays with liquid limit ≥ 50%			MH	High plasticity elastic silt	PI plots below "A" line			
				OH	High plasticity organic silt, organic clay	LL ratio < 0.75			
Highly organic soils				Pt	Peat				
				R	Rock				
Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic, R = Rock Suffix: W = Well-Graded, P = Poorly-Graded, M = Silty, L = Clay with LL<50%, H = Clay with LL≥50% Ref. ASTM D2487 for dual symbol and modifier requirements.									



BORING LOG KEY (SHEET 2 OF 2)

Particle Description	Particle Size (mm)	Retaining U.S. Sieve Size
Boulder	75 - 300	12"
Cobble	75 - 300	3"
Coarse Gravel	19 - 75	3/4"
Fine Gravel	4.75 - 19	No. 4
Coarse Sand	2.0 - 4.75	No. 10
Medium Sand	0.42 - 2.0	No. 40
Fine Sand	0.075 - 0.42	No. 200
Silt	0.002 - 0.075	Hydrometer Analysis Required
Clay	< 0.002	

Liquid Limit (LL)	Swell Potential Classification
< 20	None/Very Low
20 - 35	Low
35 - 50	Moderate
50 - 70	High
70 - 90	Very High
> 90	Extremely High

Sands and Gravels				
Relative Density (Description)	N _{SPT} (blows/ft)	N _{TCP} (blows/ft)	Friction Angle (degrees)	Relative Density (%)
Very Loose	0 - 4	0 - 8	< 30	0 - 20
Loose	4 - 10	8 - 20	30 - 32	20 - 40
Medium Dense	10 - 30	20 - 60	32 - 37	40 - 70
Dense	30 - 50	60 - 100	37 - 42	70 - 90
Very Dense	> 50	> 100	> 42	90 - 100

Silts and Clays			
Consistency	N _{SPT} (blows/ft)	N _{TCP} (blows/ft)	Unconfined Compressive Strength (tsf)
Very Soft	0 - 2	0 - 3	< 0.25
Soft	2 - 4	3 - 6	0.25 - 0.5
Firm	4 - 8	6 - 11	0.5 - 1.0
Stiff	8 - 16	11 - 22	1.0 - 2.0
Very Stiff	16 - 32	22 - 45	2.0 - 4.0
Hard	> 32	> 45	> 4.0

Penetration Range (mm/blow)	Penetration Range (in/blow)	Approximate California Bearing Ratio (CBR)	Approximate Mid-Range k-value (psi/in)
< 4	< 0.16	> 70	> 450
4 - 5	0.16 - 0.20	50 - 70	400 - 450
5 - 8	0.20 - 0.31	30 - 50	350 - 400
8 - 14	0.31 - 0.55	15 - 30	250 - 350
14 - 19	0.55 - 0.75	10 - 15	200 - 250
19 - 25	0.75 - 0.98	7 - 10	150 - 200
25 - 30	0.98 - 1.18	3 - 7	80 - 150
30 - 35	1.18 - 1.38	1 - 3	< 80
> 35	> 1.38	< 1	< 50

Risk	Soluble Sulfate Concentration (PPM)
Low	< 3,000
Moderate	3,000 - 5,000
Moderate to High	5,000 - 8,000
High to Unacceptable	> 8,000
Unacceptable	> 11,000

Hardness	N _{SPT} (blows/ft)	N _{TCP} (in./100 blows)	Unconfined Compressive Strength (psi)
Very Soft	1 - 30	> 6 in./100	< 4,000
Soft	30 - 50	4 in. - 6 in./100	4,000 - 8,000
Hard	50 - 100	2 in. - 5 in./100	8,000 - 16,000
Very Hard	>100	0 in. - 2 in./100	16,000 - 32,000
Extremely Hard	No Penetration	No Penetration	> 32,000

Rock Description	Rock Quality Designation (RQD)
Very Poor	< 0.25
Poor	0.25 - 0.50
Fair	0.50 - 0.75
Good	0.75 - 0.90
Excellent	> 0.90

Description	Meaning
Dry	No water evident in sample. Moisture content less than plastic limit.
Moist	Sample feels damp. Moisture content at or slightly above plastic limit.
Very Moist	Water visible on sample. Moisture content between plastic limit and liquid limit.
Wet	Sample contains free water.

SECTION 02 4116 DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Demolition of entire existing building shown on drawings, including concrete floor slabs, grade beams and all footings down to five (5) feet below finished grade. Include removal of existing utilities as indicated or encountered; removal of masonry, and mechanical, electrical, and plumbing items as indicated or required.
- B. Partial demolition of existing building as required to accommodate additions and renovations as shown on the drawings or required. Include removal of existing utilities as indicated or encountered; removal of masonry, and mechanical, electrical, and plumbing items as indicated or required.

1.02 SUBMITTALS

- A. Submit the following items.
 - 1. Itemized Demolition Schedule.
 - 2. Detail all demolition methods to be used.

1.03 PERMITS

- A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

1.04 QUALITY ASSURANCE

- A. Provide at least one (1) person who shall be present and in charge of the demolition work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.
- B. Comply with all pertinent codes and regulations applying to this work.

1.05 JOB CONDITIONS

- A. Use all means necessary to prevent the spread of dust during performance of this work. Inspect filters of the existing air handling system serving those areas to remain weekly and change as necessary to protect the units from construction dust.
- B. Use all means necessary to protect the existing building to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.
- C. Motor driven equipment shall have functional mufflers.
- D. Visit the site and examine the existing structure. Note all conditions as to the character and extent of work involved.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.
- B. All other materials not specifically described but required for proper completion of work of this section, shall be as selected by the Contractor subject to the approval of the Owner.
- C. The Owner and Architect are not responsible and make no claims for the quality or quantity of the materials being demolished. The General Contractor or subcontractors that undertake or assume the benefits of salvage efforts shall assume all risks associated with that effort.

2.02 DEMOLITION WORK

- A. Perform demolition work as required to complete the new construction.
- B. Perform demolition work in manner so as to allow Owner's safe use of existing facility.
- C. Perform demolition work in order to maintain Owner's construction schedule.

2.03 REMOVAL OF PARTITIONS, ROOFS, COLUMNS, STRUCTURE, AND FOUNDATION

- A. Masonry walls or other sections of masonry shall not be permitted to fall on floors in masses to exceed safe carrying capacity of floors. Floors in existing building to remain shall be properly protected with plywood where walls are to be demolished.
- B. Provide temporary shoring or bracing wherever necessary for the protection of occupants, workmen, walls, partitions, roofs, floors and structure to remain.
- C. Structural or load-supporting members shall not be cut or removed adjacent to existing structures to remain until all loads carried by members have been removed or adequately supported.
- D. No masonry walls shall be removed until it has been determined that the walls to be removed do not support the roof. To determine this, all adjacent materials such as finish ceilings shall be removed to provide adequate views of existing structure. Provide temporary shoring as needed. The Contractor shall take all precautions necessary to ensure the safety of the demolition workers and all occupants of the building.
- E. No demolition will be allowed above, below, adjacent to or near any occupied areas of the building.
- F. Demolish and remove existing foundation, including entire concrete floor slab, all grade beams, and all footings down to five (5) feet below finish grade. Backfilling, compacting and grading is specified in Section 02 20 00, Earthwork.

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.
- B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site.
- C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.
- D. Disconnect electric, telephone, gas, water, steam, or other lines servicing the structure in accordance with rules and regulations of authorities having jurisdiction, as specified, or as directed by the Architect. Coordinate all disruptions in utility services with Owner. Verify that the utility services to the existing building to remain will continue operation. Relocate and reconnect existing utilities as needed to maintain operation of the existing facility.
- E. Backfill with select fill trenches caused by demolition work.
- F. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor.
- G. Dumpsters shall not overflow and shall be emptied on a regular basis.
- H. Contractor may retain any materials he desires if the Owner has not requested them to be salvaged. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations.

- I. Keep all pedestrian areas clear for passage at all times.

3.02 MAINTAINING TRAFFIC

- A. Do not close or obstruct streets, sidewalks, parking lots, drives, trash truck passageways, without obtaining Owner's permission. Do not store materials in streets, drives, or outside of construction limits.
- B. Conduct operations with minimum interference with streets, driveways, sidewalks, and adjacent facilities.
- C. Provide, erect, maintain lights, barriers, fences as required to maintain strict security at construction site and prevent unauthorized access to area of construction site.

3.03 UTILITY LINES

- A. Seal storm or sanitary sewers leading from or through site requiring demolition. Seal, cap connections to sewers in accordance with rules, regulations of authorities having jurisdiction.
- B. Remove live water taps actually servicing site requiring demolition in accordance with rules, regulations of authorities having jurisdiction.
- C. Until acceptance, maintain, preserve existing utilities traversing premises.
- D. Backfill, tamp street openings made for removal of water taps, bulkheading house drains, or for any other purpose. Maintain street openings in safe condition. Provide barricades while actually open.

3.04 PROTECTION OF STRUCTURES, PROPERTY

- A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.
- B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.
- C. Repair damage to Owner's property or any other person or persons on or off premises by reason of required work.

3.05 DEBRIS

- A. Remove, as it accumulates, debris, except as otherwise specified, resulting from demolition operations. Do not store or permit debris to accumulate on site. If Contractor fails to remove debris promptly, Owner reserves the right to have same be removed at Contractor's expense.

3.06 MECHANICAL AND PLUMBING DEMOLITION NOTES

- A. Abandon or remove where and to the limits indicated on drawings all gas, water, sewer, and other lines as required. Remove complete all manhole structures, lines, traps, vents, revents, etc., where shown. Plug all lines to be abandoned prior to backfilling operations.

3.07 ELECTRICAL DEMOLITION NOTES

- A. Supervise and be responsible for removal of power lines, fixtures and devices where noted to be removed. Note light poles and fixtures around and within construction site scheduled to remain. Protect from damage.
- B. Disconnect electrical for removal by demolition subcontractor, as required.
- C. Work with Owner, power and telephone companies in coordinating demolition necessary for installing new service to building if needed.

END OF SECTION

SECTION 03 0516
UNDERSLAB VAPOR BARRIER

PART 1 – GENERAL

1.01 SUMMARY

- A. Products supplied under this section:
 - 1. Vapor barrier and installation accessories for installation under concrete slabs.
- B. Related sections:
 - 1. Section 03 3000 - Cast-in-Place Concrete
 - 2. Section 07 2600 - Vapor Retarders

1.02 REFERENCES

- A. ASTM International
 - 1. ASTM E1745-17 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E1643-18a Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. Technical Reference - American Concrete Institute (ACI):
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
 - 2. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.

1.03 SUBMITTALS

- A. Quality control/assurance:
 - 1. Summary of test results per paragraph 9.3 of ASTM E1745.
 - 2. Manufacturer's samples and literature.
 - 3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
 - 4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
 - 5. Contact vapor barrier manufacturer for pre-construction meeting and to coordinate a review of the vapor barrier installation either by digital review or in person.
 - 6. Vapor barrier manufacturer must warrant in writing (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
 - 7. Manufacturer verify in writing 20 years in the industry with no reported product failures.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Vapor barrier shall have all of the following qualities:
 - 1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum
 - 3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
 - 4. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
- B. Vapor barrier products:
 - 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC., (877) 464-7834 www.stegoindustries.com.

2. Approved Alternate: Vaporguard by Reef Industries, 713-507-4250.
www.reefindustries.com.
3. Approved Alternate: PMPC by WR Meadows, 800-342-5976.
<http://www.wrmeldows.com/pmpc/>
4. No substitutions.

2.02 ACCESSORIES

- A. Seams:
 1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- B. Penetrations of Vapor barrier:
 1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- C. Perimeter/terminated edge seal:
 1. Stego Crete Claw (textured tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 2. One-sided seaming tape is not a recommended method of sealing at the terminated edge.
- D. Penetration Prevention:
 1. Beast Foot by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- E. Vapor Barrier-Safe Screed System
 1. Beast Screed by Stego Industries, LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 1. Level and compact base material.
- B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

3.02 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643.
 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the slab itself using Stego Crete Claw Tape, per manufacturer's instructions.
 3. Seal vapor barrier to the entire slab perimeter using Stego Crete Claw Tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
 4. Overlap joints 6 inches and seal with manufacturer's seam tape.
 5. Apply seam tape/Stego Crete Claw to a clean and dry vapor barrier.
 6. Seal all penetrations (including pipes) per manufacturer's instructions.
 7. For interior forming applications, avoid the use of non-permanent stakes driven through the vapor barrier. Use female-threaded screed pad posts with nail holes and insert them into Beast Foot. Ensure Beast Foot's peel-and-stick adhesive base is fully adhered to the vapor barrier.
 8. If non-permanent stakes must be driven through vapor barrier, repair as recommended by vapor barrier manufacturer.
 9. Use reinforcing bar supports with base sections that eliminate or minimize the potential for puncture of the vapor barrier.
 10. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

11. For vapor barrier-safe concrete screeding applications, install Beast Screed (vapor barrier-safe screed system) per manufacturer's instructions prior to placing concrete.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Extent of concrete work is shown on drawings, including schedules, notes and details which show size and location of members and type of concrete to be poured. Furnish all labor, materials, services, equipment and hardware required in conjunction with or related to the forming, delivery and pouring of all poured-in-place concrete work.
- B. Concrete paving and walks are specified in Division 32.

1.03 QUALIFICATIONS

- A. The concrete supplier shall have a minimum of two years experience in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment. The supplier must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- B. The concrete contractor shall have a minimum of two years experience with installation of concrete similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful -service performance.
- C. Any testing laboratory retained to run certain tests required by this specification shall meet the basic requirements of ASTM E 329.

1.04 QUALITY CONTROL

- A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
- B. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
 1. ACI 301 - "Specifications for Structural Concrete for Buildings".
 2. ACI 117 - 'Specifications for Tolerances for Concrete Construction and Materials."
 3. ACI 318 - "Building Code Requirements for Reinforced Concrete".
 4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- C. Document Conflict and Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect/Engineer prior to submitting proposal. In case of conflict between and/or among the structural drawings and specifications, the strictest interpretation shall govern, unless specified otherwise in writing by the Architect/Engineer.
- D. Inspection and Testing of the Work: Materials and installed work may require testing and retesting, as directed by the governing building code or the Architect/Engineer, at any time during progress of work. The Contractor shall provide adequate notification to the Owner's Testing Agency of construction operations including the project schedule to allow the Testing Agency to schedule inspections. The Contractor shall make adequate arrangement with the Owner's Testing Agency for inspection of material stockpiles and facilities. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents. Tests not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense.
- E. Acceptance Criteria for Concrete Strength: The strength level of an individual class of concrete shall be considered satisfactory if both the following requirements are met:

1. The average of all sets of three consecutive strength tests equal or exceed the required f'c.
2. No individual strength test falls below the required f'c by more than 500 psi.
3. A strength test shall be defined as the average strength of two 6" x 12" cylinder breaks or three 4" x 8" cylinder breaks tested at the strength age indicated on the drawings for that class of concrete.
- F. Responsibility for Selection and Use of Concrete Admixtures and Chemical Treatments: The Contractor shall be responsible for selecting admixtures and surface treatments that are compatible with the intended use of the concrete including all final surface treatments called for within this or other specifications or on the structural or architectural drawings. The Contractor is responsible for following the manufacturer's instructions for the use of their product including abiding by any limitations placed by the manufacturer on the use of any of its products.
- G. Survey for Anchor Rods: The Contractor shall use a qualified land surveyor to lay out the proper location of all embedded anchor rods for columns above before they are encased in concrete. The surveyed locations of such elements shall be submitted to the Architect/Engineer for record.

1.05 PREINSTALLATION CONFERENCES

- A. Pre-Concrete Conference
 1. At least 7 days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss required methods and procedures to produce concrete construction of the required quality. Also review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing and certifications. The contractor shall send a pre-concrete conference agenda to all attendees 7 days prior to the scheduled date of the conference.
 2. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
 - a. Contractor's Superintendent
 - b. Laboratory responsible for the concrete design mix
 - c. Laboratory responsible for field quality control
 - d. Concrete Subcontractor
 - e. Ready-Mix Concrete Producer
 - f. Owner's and Architect's/Engineer's Representative
 3. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
 - a. Owner's Representative
 - b. Architect
 - c. Engineer-of-Record
 4. The Engineer shall be present at the conference. The Contractor shall notify the Engineer at least 7 days prior to the scheduled date of the conference.

1.06 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for all reinforcing steel and related accessories for the Engineer's approval. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI Standards. Submit details for steel templates that are to be used when placing dowels for columns, plinths, or pilasters out of foundation elements or for placing anchor rods for structural steel members.
- B. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including admixtures, patching compounds, epoxies, grouts, waterstops, joint systems, curing compounds, dry-shake finish materials, hardeners, sealers,

mechanical splices, hooked anchorage systems, dowel bar substitute systems, dowel bar sleeves, and others as requested by Architect/Engineer.

- C. Samples: Submit samples of materials specified if requested by Architect/Engineer, including names, sources and descriptions.
- D. Mix Designs: Submit mix designs as specified herein.
- E. Material and Mill Certificates: Provide material and mill certificates as specified herein and in the Testing Laboratory section of the Specifications. The Manufacturer and Contractor shall sign the material and mill certificates certifying that each material item complies with specified requirements. Provide certification from admixture manufacturers that chloride ion content complies with specified requirements.
- F. International Conference of Building Official (ICBO) Technical Reports: Submit technical reports of approval from ICBO for mechanical splice hooked anchorage systems, and dowel bar substitute systems.
- G. Construction Joints: Submit drawing of proposed construction joint locations in concrete for slab on grade, mat foundations, and walls. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on the drawings.
- H. Minutes of preconstruction conference.
- I. Surveys: Submit reports certifying that all anchor rods for columns above are in their proper location prior to placing of concrete.

1.07 PROVISION FOR OTHER WORK

- A. Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves in any concrete slabs except where shown on the drawings or upon written approval of the Architect/Engineer.
- B. Protect adjacent finish materials against damage and spatter during concrete placement.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. Refer to the drawings for classes and strengths of concrete required.
- B. Portland cement: ASTM C 150, Type I or Type III, or ASTM C 1157, Type GU or HE unless otherwise approved by the Architect/Engineer. For concrete exposed to salt air or salt water, provide Type II or Type V cement.
 - 1. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Owner's Testing Laboratory. Submit mill certificates certifying conformance to this specification for each brand and type of cement.
 - 2. Testing of cement in lieu of mill certificate submittal will be required if:
 - a. The cement has been in storage at the mixing site for over 30 days
 - b. It is suspected by the Owner, Architect, Engineer or Owner's Testing Laboratory that the cement has been damaged in storage or in transit or is in any way defective.
- C. Low-alkali cement: Cement that has the additional requirement that equivalent alkalis ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) do not exceed 0.60% according to ASTM C 150-00, Table 2.
- D. Fly Ash: ASTM C 618, Class C or F.
- E. Normal Weight Aggregates: ASTM C 33 and as herein specified. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate
 - 1. If required by the provisions of this specification in the section entitled "Proportioning and Design of Concrete Mixes", submit certification that aggregate does not contain any deleterious materials that react with alkalis in the concrete mix to cause excessive

expansion of the concrete for concrete that is exposed to wetting, has extended exposure to humid atmosphere, or is in contact with moist ground.

- F. Lightweight Aggregates: ASTM C 330. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.
- G. Water: Comply with the requirements of ASTM C 1602.
- H. Cementitious materials, aggregate, and water must be extracted or recovered as well as manufactured within 500 miles of the project site.
- I. Air-Entraining Admixture: ASTM C 260. Provide air entrainment as specified in Table 4.2.2.4.of ACI 301-05 in all concrete exposed to freezing and thawing. Interior steel troweled surfaces subjected to vehicular traffic shall not have more than 3% entrained air. Surfaces scheduled to receive hardeners shall not have more than 3% entrained air.
 - 1) Subject to compliance with requirements, provide one of the following products and manufacturers:
 - b. "Darex-" or "Daravair" series; W. R. Grace & Co.
 - c. "MBAE90" or "Micro-Air"; BASF Admixtures, Inc.
 - d. "Sika AER"; Sika Corporation
 - e. "Air Mix" or "AEA-92"; The Euclid Chemical Company, Inc.
 - f. "Eucon Air 30" or "Eucon Air 40", The Euclid Chemical Co., Inc.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- J. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers.
 - a. "Pozzolith 322N" or "Polyheed 997"; BASF Admixtures, Inc.
 - b. "Plastocrete 161"; Sika Chemical Corp.
 - c. "Eucon WR-75 or WR-91"; The Euclid Chemical Company, Inc.
 - d. "WRDA" series; W.R. Grace & Co.
 - e. "Eucon NW" or "Eucon LW", The Euclid Chemical Co., Inc..
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used
- K. Mid-Range Water-Reducing Admixture: ASTM C 494, Type A and Type F. See maximum permissible chloride ion content in concrete specified below.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. "Polyheed 997", BASF Admixtures, Inc.
 - b. "Eucon MR", The Euclid Chemical Company, Inc.
 - c. "Sikament HP", Sika Chemical Corp.
 - d. "Daracem" or "Mira" series, W.R. Grace & Co.
 - e. "Eucon X15" or "Eucon X20", The Euclid Chemical Co., Inc.
 - 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used
- L. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below.
 - 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. "ADVA" or "Daracem"; W.R. Grace & Co.
 - b. "Rheobuild 1000" or "Glenium 30/30"; BASF Admixtures, Inc.
 - c. "Sikament"; Sika Chemical Corp.
 - d. "Eucon 37/1037" or "Plastol" series; The Euclid Chemical Company, Inc.
 - e. "Eucon SP" or "Eucon RD", The Euclid Chemical Co., Inc.

2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.
- M. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below.
 1. Subject to compliance with requirements, provide one of the following products and manufacturers:
 - a. "Polarsert" "Gilco", "Lubricon NCA" or "DCI"; W.R. Grace & Co.
 - b. "Pozzutec 20"; BASF Admixtures, Inc
 - c. "Accelguard 80/90" "NCA", or "AcN", The Euclid Chemical Company, Inc.
 - d. "Plastocrete 161FL", Sika Chemical Co.
 - e. "Eucon AcN", The Euclid Chemical Co., Inc.
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used
- N. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below.
 1. Subject to compliance with requirements, provide one of the following products and manufacturers.
 - a. "Polarsert" "Gilco", "Lubricon NCA" or "DCI"; W.R. Grace & Co.
 - b. "Pozzutec 20"; BASF Admixtures, Inc
 - c. "Accelguard 80/90" "NCA", or "AcN", The Euclid Chemical Company, Inc.
 - d. "Plastocrete 161FL", Sika Chemical Co.
 - e. "Eucon AcN", The Euclid Chemical Co., Inc.
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used
- O. Corrosion Inhibitor: 30% calcium nitrite.
 1. Products: Subject to compliance with requirements, provide the following at dosage rates per Engineer of Record from manufacturer's recommendation based on design life, application, clear cover, and other products in concrete mix:
 2. "Eucon CIA" or "Eucon BCN", The Euclid Chemical Co.
 3. "DCI" or "DCI-S", W.R. Grace & Co.
 4. "Rheocrete CNI", BASF Admixtures, Inc.
 5. "Sika CNI", Sika Chemical Co..
- P. Corrosion Inhibitor: Amine-Ester type
 1. Products: Subject to compliance with requirements, provide the following at dosage rates per manufacturer's recommendation.
 2. "Rheocrete 222+", BASF Admixtures, Inc.
- Q. Calcium Chloride and Chloride Ion Content.:
 1. Calcium chloride or admixtures containing more than 0.5% chloride ions by weight of the admixture are not permitted.
 2. The maximum water-soluble chloride ion concentration in hardened concrete at ages from 28 to 42 days contributed from all ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits specified in ACI 301-05 Table 4.2.2.6. Water-soluble chloride ion tests shall conform to ASTM C 1218. One test shall be run for each class of concrete before the mix design submittal and each time a change is made to the mix design (such as change in aggregate type or source).
 3. The Concrete Supplier shall certify on the Mix Design Submittal Form that the chloride ion content in all concrete mix designs used on the project will not exceed limits stated above.
- R. Certification: Written conformance to all the above mentioned requirements and the chloride ion content of the admixture as tested by an accredited laboratory will be required from the admixture manufacturer at the time of mix design review by the Engineer.

2.02 QUALIFICATIONS

- A. Reinforcement.
 - 1. Reinforcing materials shall be delivered from the mill in bundles that are identified as to heat number and manufacturer and accompanied with mill and analysis test reports and an affidavit from the supplier stating that the material conforms with the requirements of the governing ASTM specification listed herein.
 - 2. Deformed bar material that is not identifiable according to the criteria listed above shall be tested for tensile strength and bend tests according to ASTM A 615 on a sample of 2 bars for each ten tons or fraction thereof of unidentified material for each bar size. The bars shall be a minimum of 24 inches long. Bend tests are not required for #14 and # 18 bars. Submit the results of such tests for record.
 - 3. Reinforcing Steel: Reinforcing steel shall conform to ASTM A 615 Grade 60 as noted on the drawings.
 - 4. Weldable Reinforcing Steel: All reinforcing steel required to be welded shall conform to ASTM A 706.
 - 5. Use Reinforcing steel made from 100% recycled material, 2/3 of which shall be post-consumer material. A minimum of 50% of the material in the reinforcement must have been extracted, harvested, or recovered as well as manufactured, within 500 miles of the project site.
 - 6. Deformed Bar Anchors: Deformed Bar Anchors shall conform to ASTM A 496 with a minimum yield strength of 75,000 PSI. Standard ASTM A 615 Grade 60 or Grade 40 reinforcing bars may not be substituted for deformed bar anchors.
 - 7. Joint Dowel Bars: Smooth bars used to dowel across slab-on-grade construction joints shall conform to ASTM A 615, Grade 40 or A36, plain-steel bars. Cut bars true to length with ends square and free of burrs.
 - 8. Dowel Bar Sleeves: Plastic or gage metal (26 ga. min.) sleeves with an inside diameter of 1/16 inch greater than the dowel bar that it encases, that have the strength, durability, and design to provide free movement of the dowel relative to the concrete slab and that are specifically manufactured for this purpose.
 - 9. Alternate Slab-on-Grade Joint Load Transfer Systems: A system that consists of flat, ASTM A 36 plate that is saw cut into a square or rectangular shape and is embedded into or encased by a plastic sleeve that allows movement in both lateral directions but not in the vertical direction. Acceptable systems are manufactured by PNA Construction Technologies with products known by the names "Diamond Dowel System" and "PD3 Basket" and Greenstreak Group Inc. with products known as "Speed Plate" and "Double-Tapered Basket".
 - 10. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge. Provide only plastic coated or stainless steel tie wire in exposed concrete structures and all architectural concrete
- B. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type or all plastic supports complying with CRSI recommendations.
 - 1. Slabs-on-Grade: Use precast concrete bar supports (dobies) or supports with sand plates or horizontal runners designed for use on ground.

2.03 SPLICES

- A. Mechanical Tension Splices: Mechanical splices shall conform to Type 1 splices in accordance with ACI 318-05, ch. 21 as expressed in an ICC-Evaluation Service Evaluation Report. The bar ends that are to attach to the splice shall be prepared and installed in accordance with the manufacturer's requirements. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Report submitted for Engineer review. The following are acceptable mechanical tension splices (splices qualified for use with grade 75 bars are parenthetically noted).
 - 1. "BarLock, S-Series", Dayton/Richmond.

2. "US/MC-SAE Mechanical Coupler", Dayton/Richmond, Inc.
 3. "DB Grout Sleeve", Dayton/Richmond
 4. "ZAP Screwlok", BarSplice Products, Inc. (qualified for use with grade 75 bars)
 5. "BPI Grip XL System", BarSplice Products, Inc.
 6. "Taper Threaded Grip Twist System, ", BarSplice Products, Inc.
 7. "Lenton Coupler", Erico Products, Inc. (for grade 75 bars, use only "Standard Coupler")
 8. "NMB Splice Sleeve", Splice Sleeve North America" (qualified for grade 75 #7 bars and higher)
 9. "BarLock, L-Series", Dayton Superior
 10. "Taperlok Couplers", Dayton Superior
 11. "Lenton Interlok", Erico Products, Inc.
 12. "Griptec", Dextra Manufacturing Co.
 13. or other Engineer-approved product.
- B. Splice Type and Lap Lengths: Required splice type and lap lengths are defined on the drawings. Lap splice lengths for unscheduled bars not shown otherwise on the drawings shall be 30 bar diameters minimum.
- C. Dowel Bar Replacement: All grade 60 reinforcing steel dowel bars shown on the drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:
1. Splice connection at insert shall develop the full tensile strength of the reinforcing steel conforming to a Type 2 splice in accordance with ACI 318-05, ch. 21.
 2. Splices shall be approved by the ICC Evaluation Service, Inc. and shall have an Evaluation Report submitted for Engineer review.
 3. The following are acceptable products (for use only with grade 60 bars):
 4. "Lenton Form Saver", , Erico Products, Inc.
 5. "DB-SAE Dowel Bar Splicer", Dayton/Richmond, Inc.
 6. or other Engineer-approved product.
- D. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576 material and shall develop the full tensile strength of the bar when installed at the manufacturer's recommended depth. The Anchorage shall be approved by the ICC Evaluation Service and shall have an Evaluation Report submitted for Engineer review. The following are acceptable products (for use only with grade 60 bars):
1. "Lenton Terminator", Erico Products, Inc.
 2. or other Engineer-approved product.

2.04 FORMWORK MATERIAL

- A. Rough-formed finished concrete: Unless otherwise specified, the default finish for formed surfaces shall be rough-form finish constructed with plywood, lumber, metal or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit. The minimum grade shall be B-C, exterior grade.
- B. Forms fFor Exposed Finish Concrete: Unless otherwise specified, formwork for exposed concrete surfaces as noted on the drawings shall consist of plywood, metal, metal-framed plywood, or other acceptable surface. Formwork shall provide a continuous straight and smooth surface conforming to the joint system as specified on the Architect's drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection. Plywood shall be exterior grade overlaid plywood complying with U.S. Product Standard PS-1, each piece showing a legible inspection trademark, and as follows:
- 1)
 2. Phenolic Surface Film Overlay over Hardwood Face, Class 1 or better.
 3. High Density Overlay (100/30 min. rating) on Hardwood Face, Class 1 or better.
 4. Medium Density Overlay on Hardwood Face,Class 1 or better, mill-release agent treated and edge sealed.

5. Structural 1, B-B, or better, mill oiled and edged sealed.
6. "B-B (Concrete Form) Plywood", Class 1, or better, mill-oiled and edge sealed.
- C. Nails and Fasteners: Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as garages, canopies and porte-cocheres.
- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to minimize spalling of concrete on removal.
 1. Exposed Surfaces: For surfaces designated with Class A and B finish tolerances, furnish units that will leave no portion of the tie closer than 3/4 inch to the plane of the concrete surface and that will leave holes not larger than 1 inch in diameter in concrete surface when the ends or end-fasteners have been removed.
 2. "B-B (Concrete Form) Plywood", Class 1, or better, mill-oiled and edge sealed
- E. Chamfer Strips: Provide wood, metal, PVC, or rubber strips, $\frac{3}{4}$ by $\frac{3}{4}$ inch, minimum.
- F. Formwork Coatings: Formwork coatings shall be not a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces or impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede curing with water or curing compounds. Provide a product that has a maximum VOC (Volatile Organic Compounds) of 450 g/l but not greater than that permitted by the local government agency having jurisdiction in the area where the project is located.
 1. Products: Subject to compliance with requirements, provide one of the following:
 2. "Enviroform", Conspec Marketing and Manufacturing Co., Inc.
 3. "Cast-Off WB", Sonneborn Building Products
 4. "Farm Fresh", Unitex
 5. Formshield WB"; Tamms Industries
 6. "Form-Eze Natural", The Euclid Chemical Company, Inc.
 7. "Bio-Form", Universal Form Clamp
 8. "Aqua Blue", US Spec

2.05 RELATED MATERIALS

- (a) Waterstops: Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints. Provide flat, dumbbell type or centerbulb type.
2. Polyvinyl chloride (PVC) waterstops: Corps of Engineers CRD-C 572.
 - a. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - (1) BoMetals, Inc.
 - (2) Greenstreak Group, Inc.
 - (3) Progress Unlimited, Inc.
 - (4) Vinylex Corp.
 - (5) Paul Murphy Plastics, Co.
 - (6) Sternson Group
 - (7) Tamms Industries Co.; Div. Of LaPorte Construction Chemicals of North America, Inc.
 - (8) Westec Barrier Technologies; Div. Of Western Textile Products, Inc.
3. Preformed Plastic Waterstops: Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints".
 - a. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - (1) Synko-Flex Products, Inc.
4. Sodium Bentonite with Butyl Rubber: Volclay Waterstop RX manufactured by Cetco Building Materials Group

- B. Vapor Barrier: Provide vapor barrier chosen from products specified below over prepared base material where indicated.
1. Plastic Vapor Barrier: Provide a flexible, preformed sheet membrane conforming to ASTM E 1745 with the following properties.
 - a. Class A material
 - b. Minimum of 15 mils thick
 - c. Maximum water vapor permeance rating of 0.02 as tested by ASTM E 96
 - d. Acceptable products include the following:
 - (1) "Stego Wrap Vapor Barrier (15 mil)", Stego Industries, LLC
 - (2) "Griffolyn Vaporguard" Reef Industries
 - (3) "Perminator (15 mil)", W.R. Meadows
 - (4) "Viper Vaporcheck (16 mil)", Insulation Solutions, Inc.
 2. Tape for Plastic Moisture Retarders: High-density polyethylene tape with pressure sensitive adhesive having a minimum width of 4 inches.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171:
1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.
 4. Polyethylene-coated natural cellulose fabric such as "Aquacure" by Greenstreak Group, Inc.
- E. Non-Oxidizing Metallic Floor Hardener: Packaged dry, combination of materials consisting of Portland Cement, non-rusting aggregate and plasticizing admixtures.
1. "Diamond Plate," Euclid Chemical Company
 2. "Lumiplate," BASF Building Systems.
- F. Liquid Membrane-Forming Curing and Sealing Compounds:
1. Water-Based Dissipating Resin Type Curing Compound: Curing Compound shall be a dissipating resin type, which chemically breaks down after approximately 4 weeks. Membrane forming compound shall meet ASTM C 309, Types 1 and 1D Class B.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) "Kurez DR Vox" or "Kurez W Vox", Euclid Chemical Company
 - (2) "L&M Cure R", L&M Construction Chemicals
 - (3) "Horncure WB 30", Tamms Industries
 - (4) "Hydro Cure 309", Unitex
 - (5) "Sealtight 1100-Clear", W. R. Meadows
 - (6) "US Spec Maxcure Resin Clear", US Mix Co.
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied. Submit any instructions that must be followed prior to any subsequent surface treatments and floor coverings.
 2. High Solids, Water-Based Acrylic Curing and Sealing Compound with Moderate Yellowing Characteristics: Water-Based membrane-forming curing and sealing compound conforming to ASTM C 1315, Type 1, Class B, classified as low odor. Product shall provide a maximum moisture loss of 0.030 Kg/m² in 72 hours when applied at a coverage rate of 300 sf/gallon. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, resilient flooring, or adhesives, or other coating or finishing products.
 - a. Products: Subject to compliance with above requirements, provide one of the following products or equivalent products:
 - (1) "Safe Cure and Seal (J-19)"; Dayton Superior Corp.
 - (2) "Super Aqua-Cure VOX"; Euclid Chemical Co.

- (3) "Dress & Seal, 30 WB"; L & M Construction Chemicals, Inc.
- (4) "Masterkure 200W"; BASF Building Systems.
- (5) "Hydro 18", Unitex
- b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied.
Submit any instructions that must be followed prior to any subsequent surface treatments.
- 3. High Solids, Water-Based, Non-Yellowing Curing and Sealing Compound: Water based membrane-forming curing and sealing compound, acrylic type, complying with ASTM C 1315, Type 1, Class A classified as low odor. Do not apply to surfaces that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, resilient flooring, or adhesives, or other coating or finishing products.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) "Super Diamond Clear Vox", Euclid Chemical Company
 - (2) "Lumiseal 30 WB", L&M Construction Chemicals
 - (3) "Kure 1315", BASF Building Systems
 - (4) "Hydro Seal 30", Unitex
 - (5) "Vocomp 30", W. R. Meadows
 - (6) "US Spec Radiance UV-25", US Mix Co.
 - (7) "Luster Seal WB 300", Tamms Industries.
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with any covering or surface treatments to be applied.
Submit any instructions that must be followed prior to any subsequent surface treatments
- G. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss in hot weather conditions.
 - 1. Products: Subject to compliance with requirements, provide one of the following.
 - a. "Eucobar"; Euclid Chemical Company
 - (1) "E-Con"; L & M Construction Chemical, Inc.
 - (2) "Confilm"; BASF Building Systems
 - (3) "Sure Film (J-74)", Dayton Superior
 - (4) "SikaFilm", Sika Chemical Co.
 - (5) "Pro-Film", Unitex
 - (6) "Sealtight Evapre", W. R. Meadows
 - (7) "US Spec Monofilm ER", US Mix Co..
 - b. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings and surface treatments to be applied.
Submit any instructions that must be followed prior to any subsequent surface treatments.
 - H. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.
 - 1)
 - b. Products: Subject to compliance with requirements, provide one of the following:
 - (1) "Surfhard"; Euclid Chemical Co.
 - (2) "Lapidolith"; BASF Building Systems
 - (3) "Day-Chem Hardener (J-15)," Dayton Superior
 - (4) "Fluohard", L & M Construction Chemical, Inc.
 - (5) "Penalith", W. R. Meadows
 - c. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all coverings or surface treatments to be received.
Submit any instructions that must be followed prior to any subsequent surface treatments.

- I. Liquid Sealer/Densifier: High performance, deeply penetrating concrete densifier that is an odorless, colorless, VOC-compliant, non-yellowing silicate-based solution containing a minimum solids content of 20%, 50% of which is silicate.
 1. "Euco Diamond Hard", Euclid Chemical Co.
 - a. "Seal Hard", L & M Construction Chemical, Inc.
 - b. "Luqui-Hard", W.R. Meadows
- J. Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic and/or nonstructural repairs.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Acrylic or Styrene Butadiene:
 - (1) "Day-Chem Ad Bond (J-40)"; Dayton Superior
 - (2) "SBR Latex"; Euclid Chemical Co.
 - (3) "Daraweld C"; W. R. Grace.
 - (4) "Acrylic Additive," BASF Building Systems, Inc.
 - (5) "SikaLatex", Sika Chemical Co.
 - (6) "Intralok", W. R. Meadows
 - (7) "US Spec Acrylcoat", US Mix Co.
 - (8) "Akkro 7-T", Tamms Industries
 - b. Polyvinyl Acetate (Interior Use Only).
 - (1) "Euco Weld"; Euclid Chemical Co.
 - (2) "Everweld"; L & M Construction Chemicals, Inc.
 - (3) "Superior Concrete Bonder (J-41)," Dayton Superior
 - (4) "US Spec Bondcoat", US Mix Co.
- K. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C 881, for use in all structural concrete repairs.
 1. Products for Crack Repair:
 - a. "Sikadur 35 Hi Mod LV"; Sika Chemical Company – injection type
 - b. "Sikadur 52", Sika Chemical Company – injection type
 - c. "Sikadur 55 SLV", Sika Chemical Company – gravity feed
 - d. "Eucopoxy Injection Resin," Euclid Chemical Company
 - e. "Sure-Inject (J-56)," Dayton Superior
 - f. "Epofil SLV", BASF Building Systems
 - g. "ETI-LV" or "ETI-GV", Simpson Strong-Tie Co., Inc. – injection type
 - h. "Pro-Poxy 100 LV" or "Pro-Poxy 50", Unitex
 - i. "Crackbond", U.S. Anchor Corp.
 - j. "Rezi-Weld LV", W. R. Meadows
 - k. "US Spec Maxibond" US Mix Co. – injection or gravity feed
 - l. "US Spec Eposeal LVS", US Mix Co. – gravity feed
 - m. "Duralcrete LV", Tamms Industries.
 2. Products for Epoxy Mortar Patches:
 - a. "Sikadur Lo-Mod LV"; Sika Chemical Corporation.
 - b. "Euco 352 LV," Euclid Chemical Company
 - c. "Sure Grip Epoxy Grout (J-54)," Dayton-Superior
 - d. "Epofil", BASF Building Systems
 - e. "Pro-Poxy 2500", Unitex
 - f. "Rezi-Weld 1000", W. R. Meadows
 - g. "US Spec EPM 3000", US Mix Co.
 - h. "Duralcrete LV", Tamms Industries
 3. Products for Epoxying Steel Plates to Concrete: Conform to ASTM C 881-90, Type IV, Grade 3, Class A, B, & C except gel times.
 - a. "Sikadur 31 Hi-Mod Gel"; Sika Corporation
 - b. "Euclid 452 Gel," Euclid Chemical Company

- c. "Sure Anchor I (J-S1)," Dayton Superior
- d. "Epo Gel" or "Rapid Gel". BASF Building Systems
- e. "Pro-Poxy 200", Unitex
- f. "US Spec Gelbond NS" US Mix Co.
- g. "Duralcrete Gel", Tamms Industries.
- 4. Products for Adhesive Anchors or Reinforcing Steel in Normal-weight Concrete: Product that conforms to ASTM C 881-02, Type IV, Grade 3, Class A, B, & C except gel times, and that is dispensed from a two-component cartridge system through a mixing nozzle that thoroughly mixes the two components as it is injected into the hole. The product must show approval by the ICC Evaluation Service of having passed Acceptance Criteria 308 as evidenced by an Evaluation Service Report (ESR). Consult with the manufacturer for the minimum temperature of the concrete surface allowed.
 - a. Normal-weight concrete.
 - (1) "HIT-RE 500-SD", Hilti Fastening Systems
 - (2) "SET-XP" Adhesive", Simpson Strong-tie
 - (3) "PE 1000+", Powers Fasteners, Inc.
 - b. Light-weight Concrete:
 - (1) No approved products
 - c. These products may not be used in concrete cast over corrugated deck.
- L. Anti-Corrosive Epoxy/Cementitious Adhesive: Water-based epoxy/cementitious compound for adhesion and corrosion protection or reinforcing members (20 hour maximum open time).
 - 1. Products:
 - a. "Corr-Bond," Euclid Chemical Co.
 - b. "Armatec 110," Sika Chemical Co.
 - c. "Sonoprep Plus", BASF Building Systems
- M. Expansion Anchors in Concrete:
 - 1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report showing having passed Acceptance Criteria 193 and
 - 2. approval for use in cracked concrete and resisting wind and seismic loads shall be approved for use.
 - 3. Type: All expansion anchors in concrete shall be only wedge type expansion, sleeve type expansion or undercut type bolts.
 - 4. Interior Use: All expansion anchors, nuts and washers for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
 - 5. Exterior or Exposed Use: All expansion anchors, nuts and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized bolts, nuts and washers shall conform to ASTM A 153. Stainless steel bolts shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or Type 18-8 stainless steel.
 - 6. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the bolts.
 - 7. Acceptable Products and Manufacturers – Normal and Lightweight Concrete:
 - a. "Kwik Bolt TZ", "HDA Undercut Anchor" and "HSL-3 Heavy Duty Sleeve Anchor",
 - b. Hilti Fastening Systems
 - c. "Strong-Bolt Wedge Anchor", Simpson Strong-Tie, Co, Inc.
 - d. "Red Head Trubolt + Wedge Anchor", ITW Red Head
 - e. "DUC Undercut Anchor", USP Structural Connectors "Power Stud + SD2", Powers Fasteners, Inc
 - f. "SRS TZ Carbon Steel Anchor", MKT Metall-Kunststoff-Technik
 - g. "Torq-Cut Self Undercutting Anchor", Simpson Strong-Tie, Co. Inc. (ESR Pending).
 - 8. Acceptable Products and Manufacturers – Normal and Light Weight Concrete on Corrugated Deck:

- a. "Kwik Bolt TZ", Hilti Fastening System
 - b. Strong-Bolt Wedge-Anchor", Simpson Strong-Tie, Co, Inc.
 - c. Power Stud + SD2", Powers Fasteners, Inc.
 9. Substitutions for products noted in the drawings may be considered provided complete technical information and job references are furnished to the Engineer for approval prior to commencement of work. Failure to obtain approval for anchor substitutions will render the contractor liable for the design and performance of the anchor
- N. Screw Anchors in Concrete
1. Approvals: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report showing having passed Acceptance Criteria 193 and approved for use in cracked concrete and resisting wind and seismic loads shall be approved for use.
 2. Interior Use: All screw anchors for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
 3. Exterior or Exposed Use: All screw anchors for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel.
 4. Acceptable Products and Manufacturers – All Conditions:
 - a. "Titen HD", Simpson Strong-Tie Co., Inc.
 - b. "Snake+Anchor" Powers Fasteners, Inc.
 - c. "Wedge-Bolt+", Powers Fasteners, Inc. (greater than $\frac{1}{4}$ in. diameter)
 5. Substitutions for products noted in the drawings may be considered provided complete technical information and job references are furnished to the Engineer for approval prior to commencement of work. Failure to obtain approval for anchor substitutions will render the contractor liable for the design and performance of the anchor
- O. Threaded Rods Chemically Anchored in Concrete
1. Type; Threaded rods installed in holes using a chemical anchoring process shall have a 45° chiseled end on one end.
 2. Interior Application; Meet the requirements of ASTM A 307, A 36 or A 193, grade B7.
 3. Exterior Application: Meet the requirements of ASTM A 153 galvanized steel, or F 593, Group 1 or 2, condition CW stainless steel.
- P. Anchor Rods:
1. All anchor rods shall conform to ASTM F 1554 unless noted otherwise on the drawings and shall be of the yield strength as specified below as appropriate for the types and at the locations as specified on the drawings:
 2. ASTM F 1554, Grade 36 (1/4 inch to 4 inches in diameter).
 3. Anchor rods used with galvanized baseplates shall be galvanized.
 4. Nuts: All nuts with anchor rods shall be heavy hex head conforming to ASTM A 563.
 5. Washers: Unless noted otherwise on the drawings, washer size and thickness for all anchor rods shall conform to Table 14-2 of AISC "Steel Construction Manual" with holes $1/16$ " greater than the anchor rod diameter. Washers shall conform to ASTM A 36 steel
- Q. Reglets: Where resilient or elastomeric sheet flashing or bituminous membrane is terminated in reglets, provide reglets of not less than 26 gage galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- R. Carton Forms: Carton forms shall be manufactured using corrugated paper material with a moisture resistant exterior surface and specifically designed for foundation support. Carton forms shall be designed to support the wet weight of the concrete that is shown by the details to be poured on top of the form but not less than 600 psf. Refer to the Reinforced Concrete General Notes for the restriction on horizontal construction joints. The forms shall be designed in such a way that the bottom of the form will collapse when acted upon by upward movement of the soil.

1. Form Configuration: Carton forms shall be of a vertical cellular configuration only, except as permitted by item 5 below, and shall be rectangular as shown on the details. The depth of the carton forms is shown on the details. Forms shall be manufactured to fit snugly against round piers and shall be baffled in such a way as to prevent concrete from flowing back into the form during the concrete pour. The Contractor shall use expandable foam to fill all gaps and holes between carton forms and at intersections with foundations.
2. Carton forms shall be kept dry and protected until concrete is poured. Wet, compressed, or deteriorated carton forms shall not be used. Do not wrap or cover carton forms with polyethylene sheets or permanent waterproof cover as that will prevent proper deterioration of the forms.
3. Technical data and brochures on carton forms shall be submitted for Engineer's review.
4. Other types of forms using different types of paper and different configurations will be accepted if it can be shown by independent tests that the form will properly function and will deteriorate due to moisture in an appropriate time frame.
5. For slab conditions, cover carton forms with a 1/4 inch masonite protection cover board to prevent puncture and other damage during construction.
6. Products: Subject to requirements, acceptable manufacturers include but are not limited to the following:
 7. SureVoid Products, Inc., Englewood, CO
- S. Contraction and Construction Joint-Filler Material for Slabs-on-Grade: Provide a 2-component semi-rigid, 100% solids epoxy having a minimum shore A hardness of 75 when tested in accordance with ASTM D 2240. Subject to compliance with requirements, provide one of the following:
 1. "Euco 700", Euclid Chemical Co., Inc.
 2. "Spec-Joint CJ"; Conspec Marketing and Manufacturing Co., Inc.
 3. "Masterfill 300 I", BASF Building Systems
 4. "MM-80", Metzger/McGuire Co.
 5. "Rezi-Weld Flex", W. R. Meadows
 6. "US Spec SR-50 EJF", US Mix Co
- T. Joint-Filler Strips for Isolation Joints in Slabs-on-Grade: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork
- U. Bondbreaker for Construction Joints in Slabs-on-Grade: A dissipating bondbreaking compound containing no silicones, resins, or waxes, and that conforms to ASTM C 309. Subject to compliance with requirements, acceptable manufacturers include the following:
 1. "Sure-Lift", Dayton Superior Corporation, Inc.
 2. "Tilt-Eez", Conspec Marketing and Manufacturing Co., Inc
- V. Rigid-Cellular-Polystyrene Boards use as Fill under Topping Slabs or Slabs-on-Grade: Provide rigid, expanded (EPS) or extruded (XPS) cellular polystyrene boards that conform to ASTM D 6817 or ASTM C 578 with a minimum density of 29 kg/m³. Subject to compliance with requirements, acceptable manufacturers include the following:
 1. "STYROFOAM Brand" Dow Chemical Company
 2. "R-Control EPS Geofoam" - All grades, R-Control Building Systems "EPS Geofoam", Carpenter Co.
 3. "Knauf Geofoam", Knauf Polystyrene "Insulfill", Premier Industries

2.06 PROPORTIONING AND DESIGN OF CONCRETE MIXES

- A. The Contractor shall submit for approval by the Engineer and Owner's Testing Laboratory, at least 15 working days prior to the start of construction, concrete mix designs and the Concrete Mix Design Submittal Form located at the end of this specification section for each class of concrete indicated on the structural drawings and in the Specifications. If required, the Contractor shall engage the services of an independent Testing Laboratory to assist in preparing the mix design. The Contractor shall not begin work with a particular mix until that mix design has been approved.

- B. The Contractor, acting in conjunction with his Concrete Supplier and his Testing Laboratory, shall submit in writing, with his mix designs, the method used to select mix proportions. Either of the following methods, as outlined in ACI 301, may be used.
 - 1. Field Experience Method
 - 2. Laboratory Trial Mixture Method
- C. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings.
- D. All mix designs shall state the following information:
 - 1. Mix design number or code designation by which the Contractor shall order the concrete from the Supplier.
 - 2. Structural slab or member for which the concrete is designed (i.e. columns, shear walls, footings, slab on grade, etc.).
 - 3. Wet and dry unit weight.
 - 4. 28 day compressive strength.
 - 5. Aggregate type, source, size, gradation, fineness modulus.
 - 6. Cement type and brand.
 - 7. Fly ash or other pozzolan type and brand (if any).
 - 8. Admixtures including air entrainment, water reducers, high-range water reducers, accelerators, and retarders.
 - 9. Design Slump or Slump/Flow.
 - 10. Proportions of each material used.
 - 11. Water/cementitious ratio and maximum allowable water content.
 - 12. Method by which the concrete is intended to be placed (bucket, chute, or pump).
 - 13. Required average strength qualification calculations per ACI 301 4.2.3.3a and 4.2.3.3b.
Submit separate qualification calculations for each production facility that will supply concrete to the project.
 - 14. Documentation of Average strength (trial mix data or field test data) per ACI 301: When field test data is used to qualify average strength, submit separate documentation for each production facility that will supply concrete to the project.
 - 15. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.
 - 16. All other information requested in the Concrete Mix Design Submittal Form located at the end of this specification section.
- E. Low Alkali Concrete: The total alkali contribution from cementitious materials in the concrete mix shall not exceed 4.0 pounds per cubic yd of concrete unless the aggregate used is certified to contain no deleterious materials that react with alkalis in the concrete mix as defined in ASTM C 33. This requirement may be met by the use of low-alkali cement.
- F. Supplementary Cementitious Materials: Fly ash replacement of Portland cement shall not exceed 25% unless otherwise approved. If fly ash is used, it must be at a minimum fly ash replacement level of 15%. Approval for higher levels will be based on showing experience of satisfactory performance on other projects using materials from identical sources as proposed for this project. Submit evidence of such experience on other projects.
- G. Aggregate: Comply with the following special requirements:
 - 1. For exposed concrete, provide aggregates from a single source.
 - 2. For exterior exposed surfaces, do not use aggregates containing spalling-causing deleterious substances.
 - 3. For slabs and other designated concrete, combined aggregate gradation shall be 8% - 18% for large top size aggregates (1 1/2 in.) or 8% - 22% for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100. Deviations from this gradation may be allowed upon the approval of the Engineer subject to the following limitations:
 - 4. The percent retained on two adjacent sieves shall be not less than 5%.
 - 5. The percent retained on three adjacent sieves shall be not less than 8%

6. If the percent retained on two adjacent sieves is less than 8%, the total percent retained on either of those sieves and the adjacent outside sieve shall be not less than 13 %
- H. Admixtures:
1. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Owner's Testing Laboratory and shall be used for the purpose intended by the manufacturer to produce concrete to meet the specified requirements.
 2. Quantities of admixtures to be used shall be in strict accordance with the manufacturer's instructions.
- I. Lightweight Structural Concrete:
1. Comply with the requirements of ACI 211 and ACI 301.
 2. Provide concrete with a dry unit weight of not more than 116 pounds per cubic foot and not less than 110 pounds per cubic foot. Design mix to produce strengths as indicated on the drawings with a split cylinder strength factor ($f_{ct}/f'c$) of not less than 5.7.
- J. Adjustments of Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such mix design adjustments shall be provided at no additional cost to the Owner.
- K.
- L. Any adjustments in approved mix designs including changes in admixtures shall be submitted in writing with the specified Concrete Mix Design Submittal Form to the Engineer and Owner's Testing Laboratory for approval prior to field use.
- M. Chloride Ion Content: A written submittal shall be made with each mix design proposed for use on the project that the chloride ion content from all ingredients including admixtures will not exceed the limits specified in this section of the Specifications.

2.07 CONCRETE MIXES

- A. Ready-Mix Concrete: Comply with requirements of ANSI/ASTM C 94, "Ready Mixed Concrete" and this specification.

PART 3 - EXECUTION

3.01 FABRICATION AND CONSTRUCTION OF FORMWORK

- A. Design, erect, support, brace and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic construction loads that might be applied until the concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 117.
- C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. 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 steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace

temporary openings and patch forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

- G. Chamfer exposed corners and edges as indicated, using specified chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

3.02 CLEANING AND TIGHTENING

- A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and all other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.03 CLEANING AND RE-USE OF FORMS

- (a) Forms reused in the work shall be repaired and cleaned. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable for exposed surfaces. Forms intended for successive concrete placement shall have surfaces cleaned, fins and laitance removed, and joints tightened to avoid surface offsets. New form coating compound shall be applied to reused forms. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.04 TOLERANCES

- A. Unless specified otherwise, all tolerances for concrete formwork shall conform to ACI Standard 117, "Standard Tolerances for Concrete Construction and Materials". Before concrete placement the Contractor shall check lines and levels of erected formwork and make any corrections and adjustments as required to ensure proper size and location of concrete members and stability of forming systems. During concrete placement the Contractor shall check formwork and supports to ensure that forms have not displaced and that completed work will be within specified tolerances.
- B. Construct forms so as to limit the offset between adjacent pieces of formwork facing material in accordance with the following classifications as defined in ACI 117. The offset limits shall apply to both abrupt and gradual variations in the surfaces.
 1. Class A, 1/8 inch, for surfaces prominently exposed to public view in the completed structure where appearance is of special importance or architecturally exposed concrete where indicated on the drawings.
 2. Class C, 1/2 inch, other surfaces exposed to view but not scheduled to receive other finishes.
 3. Class D, 1 inch, all other surfaces.

3.05 REMOVAL OF FORMS AND SUPPORTS

- A. Records of Weather Conditions: The General Contractor shall be responsible for keeping records of weather conditions to be used in the decision on when to remove forms.
- B. Formwork Not Supporting Concrete: Formwork not supporting concrete such as sides of walls and similar parts of the structure, may be removed after cumulatively (not necessarily consecutively) curing at not less than 50°F for 12 hours after placing concrete, provided the concrete is sufficiently hard so as not to be damaged by form removal operations and provided curing and protection operations are maintained. If ambient air temperatures remain below 50°F, if retarding agents are used, or if Type II and Type V portland cement is used, then this

specified minimum period should be increased as required to safely remove the forms without damage to the concrete. Where such forms also support formwork for slab or beam soffits, the removal times of the latter shall govern.

3.06 FABRICATION AND DELIVERY OF REINFORCEMENT

- A. Bending and Forming: Fabricate bars of indicated sizes and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars shall be free from injurious defects, have a workman-like finish with no excessive rust and/or pitting and have no unusual kinks or bends.
- B. Marking and Shipping: Bundle reinforcement and tag in accordance with section 7.4.5 of the CRSI "Manual of Standard Practice". Transport and store at site so as not to damage material. Keep sufficient supply of tested, approved and proper reinforcement at the site to avoid delays. Maintain reinforcing bars free of mud, dirt, grease, or other coating.

3.07 PLACING REINFORCEMENT

- A. 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.
- B. Before placing and again before concrete is placed, clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by chairs, runners, bolsters, spacers and hangers, as required. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide metal spreaders and spacers to hold steel in position. Support steel at proper height upon approved chairs.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Coordinate with other trades and expedite materials and labor to avoid omissions and delay.
- F. Install waterproof membrane or vapor barrier as specified prior to placing steel for concrete slabs-on-grade.
- G. Extend reinforcement continuous through construction joints unless otherwise shown on the drawings or, if approved on the shop drawings, provide dowels of sufficient length to develop the full tension or compression strength of the bar as applicable.
- H. Slab-on-Grade Joint Dowel Bars: Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve specifically manufactured for the purpose of preventing a bond between the dowel and the concrete.
- I. Alternate Slab-on-Grade Joint Load Transfer Systems: Install the load transfer system in accordance with the manufacturer's direction such that the horizontal plane of the flat plate is parallel to the plane of the subgrade on which the slab is bearing.
- J. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide required additional reinforcing steel at no additional cost to the Owner.
- K. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum

3.08 SPLICING REINFORCING STEEL

- A. Provide splice type (tension lap splice, compression lap splice, compression end bearing splice, or mechanical anchorage tension splice) as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.
- B. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
- C. Maintain proper cover between reinforcing bars at splices.
- D. Lap unscheduled reinforcing bars not otherwise specified a minimum of 30 bar diameters at splices. Lap welded wire fabric a minimum of one full wire mesh plus two inches.

3.09 WELDING REINFORCING STEEL

- A. Welding reinforcing steel is permitted only where specifically shown on the drawings. All welding shall conform to AWS D1.4 "Structural Welding Code - Reinforcing Steel". Only weldable reinforcing steel conforming to ASTM A 706 or deformed bar anchors conforming to ASTM A 496 shall be permitted. ASTM A 615 bars may not be welded for structural use.

3.10 SLUMP LIMIT

- A. The slump, as measured in the field where concrete cylinders are taken, shall be within plus or minus 1 inch of the design slump noted on the Mix Design Submittal Form. Water may be added to the concrete in the field only to the extent that the prescribed water/cementitious ratio noted in the Mix Design Submittal Form is not exceeded.

3.11 VAPOR BARRIER INSTALLATION

- A. Install vapor barrier in accordance with ASTM E 1643 and manufacturer's instructions.
- B. Seal all joints in the field with the specified pressure sensitive tape. Heat-welded joints done in a shop prior to delivery is an acceptable method to minimize the number of field joints.
- C. Seal all pipe penetrations through the moisture retarder with a boot made from the moisture retarder material and tape.

3.12 JOINTS IN CONCRETE

- A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.
 1. Keyways: Provide keyways with a depth of one tenth of the member thickness (1 1/2" minimum or as shown on the drawings) in construction joints only where shown on the drawings.
 2. Joint Construction: Place construction joints in the center one third of grade beams and as shown on the drawings for slabs-on-grade and walls unless shown otherwise. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise shown on the drawings. Dowels that cross construction joints shall be supported during concreting operations so as to remain parallel with the slab or wall surface and at right angles to the joint. Submit all construction joint locations as a shop drawing submittal.
 3. Waterstops: Provide waterstops in construction joints as indicated on the Architectural and Structural Drawings. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.
 4. Isolation Joints in Slabs-on-Ground: Construct isolation joints (without dowels) in slabs-on-ground at points of contact between slabs on ground and vertical surfaces only where specifically detailed on the drawings. Install joint-filler strips at joints where indicated. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on the drawings. Install joint-filler strips in lengths as

long as practicable. Where more than one length is required, lace or clip sections together. Provide construction joints with dowels at all locations unless isolation joints are detailed.

6. Contraction (Control) Joints in Slabs-on-Ground: Maximum joint spacing shall be 36 times the slab thickness or 20 feet, whichever is less and at a minimum on column lines unless otherwise noted on the drawings. Use one of the two following methods (sawed or formed) to create the joints. Do not use the formed joint in areas subject to vehicular traffic.
 - a. Sawed Joints
 - (1) Primary Method: Early-Entry, dry-cut method, by Soff-Cut International, Corona, CA (800) 776-3328. Finisher must have documented successful experience in the use of this method prior to this project. Install cuts within 1 to 4 hours, depending on air temperature, after final finish as soon as the concrete surface is firm enough to not be torn or damaged by the blade at each saw cut location. Use 1/8 inch thick blade, cutting 1 1/4" inch into the slab.
 - (2) Optional Method (where Soff-Cut System method equipment is not available, subject to limitations): This method may not be used when there is no dowel passing through the contraction joint. Use a conventional saw to cut joints within 4 to 12 hours after finishing as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use 1/8 inch thick blade, cutting to a depth of 1/4 of the slab thickness but not less than 1 inch. Cut to a depth of 1/3 slab thickness for slabs reinforced with steel fibers.
 - b. Formed Joints: Form contraction joints by inserting premolded plastic hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. The depth is to be 1/4 the slab thickness, but not less than 1 inch. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
 - c. Joint Filler: Provide in both contraction and saw-cut construction joints when specified.
 - (1) Remove dirt and debris from the joint by vacuuming immediately prior to filling joint. Clean the joint of curing compounds and sealers.
 - (2) Filler material shall be applied to the joints when the building is under permanent temperature control, but no less than 90 days after slab construction.
 - (3) Follow the manufacturer's recommended procedure for installing filler material. The joint filler must be flush with the adjacent concrete. A concave profile on the top of the joint filler is unacceptable and will be grounds for removal and replacement.
 - d. The Contractor shall protect the joints from damage caused by wheeled traffic or other sources during construction until a joint-filler material (if specified) has been installed

3.13 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto unless directed otherwise by these specifications. Install reglets to receive top edge of foundation sheet waterproofing where specified by the Architect, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles and other conditions.
- B. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work as shown on the drawings. Furnish 1/8" minimum steel

templates for presetting rods and other anchors to accurate locations as shown on the drawings in keeping with the tolerances noted in ACI 117 for embedded anchor rods..

- C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.
- D. Do not install sleeves in concrete slabs, pier caps, footings or walls except where shown on the structural drawings or approved by the Architect and Engineer.
- E. Securely fasten embedded plates, angles, anchor rods and other items to be built into the concrete to the formwork or hold in place with templates. Insertion of these items into concrete after casting is prohibited.

3.14 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- C. Comply with ACI 301 and as herein specified.
 - 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation. Spread concrete using short-handled, square-ended shovels, or come-alongs.
 - 2. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use internal vibrators of the largest size and power that can properly be used in the work as described in the table entitled "Range of characteristics, performance, and applications of internal vibrators" found in ACI 301.
 - 4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
 - 5. 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.
 - 6. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners of forms, eliminating air and stone pockets that may cause honeycombing, pitting, or planes of weakness.
 - 7. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats or darbies to smooth surface free of humps or hollows before excess moisture or bleedwater appears on the surface. Do not disturb slab surfaces prior to beginning finishing operations.
 - 8. Maintain reinforcing in proper position during concrete placement operations.
 - 9. Placing Concrete by Pump: If concrete is placed by using a pump, the grout used for pump priming must not become a part of the completed structure unless an engineered grout design mix and grout location are approved in advance by the Engineer.

3.15 FINISH OF FORMED SURFACES

- A. Rough Form Finish: Provide rough form finish for formed concrete surfaces not otherwise scheduled on the drawings to receive a smooth-form finish. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. Smooth Form Finish: Provide smooth form finish for formed concrete surfaces as scheduled on the drawings, which may include those exposed-to-view or that are to be covered with a coating or covering material applied directly to concrete such as waterproofing, dampproofing, painting, veneer plaster or other similar system or to a surface that is to receive a smooth rubbed finish or grout cleaned finish. This is an as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections exceeding 1/8 inch in height removed and smoothed.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.16 MONOLITHIC SLAB FINISHES

- A. Place, consolidate, strike off, and level concrete, eliminating high spots and low spots, before proceeding with any other finish operation. Do not add water to the surface of the concrete during finishing operation.
- B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.
- C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using a hand float, a bladed power float equipped with float shoes, or a powered disk float, when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. Check and level surface plane to a tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system. After floating, begin first trowel finish operation by hand or power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to a tolerance as specified below. Grind smooth surface defects which would telegraph through applied floor covering system.
- E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply initial trowel finish as specified above, then immediately follow with slightly scarifying surface by fine brooming.
- F. Slip-Resistive Broom Finish: Apply slip-resistive broom finish to ramps less than 6% slope, exterior concrete platforms, steps and ramps and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

- G. Roller-Bug Finish: Provide a roller-bug finish with a minimum $\frac{1}{4}$ " amplitude to all ramps exceeding a 6% slope. Extend the finish as least 12 feet beyond the beginning and ending of the greater-than-6% ramp. The finish shall be imprinted on the concrete by the use of a roller-bug tamper.
- H. Liquid Sealer/Densifier Finish: Apply liquid sealer/densifier finish to exposed interior concrete floors where indicated. Apply liquid liquid sealer/densifier after complete curing and drying of the concrete surface and in strict accordance with manufacturer's printed instructions.
- I. Slip-Resistive Aggregate Finish: Apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps and elsewhere as indicated on the Architect's or Structural Drawings.
- J. After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened slip-resistive aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
- K. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose slip-resistive aggregate
- L. Non-Oxidizing Metallic Floor Hardener: Slabs in areas noted on the drawings shall receive an application of the non-oxidizing, metallic floor hardener applied at the rate of 150 lbs. Per 100 sq. ft. Immediately following the first floating operation, uniformly distribute approximately 2/3 of the required weight of the hardener over the concrete surface by mechanical spreader and embedded by means of power floating. The hardener shall be floated in and the second application made. The surface shall be floated again to properly bond the hardener to the base concrete slab. The surface shall then be troweled at least twice to a smooth dense finish.

3.17 CONCRETE FINISH MEASUREMENT AND TOLERANCES

- A. Testing Procedure: ASTM E 1155:
- B. Tolerance on Floor Elevations: Construction tolerance on absolute floor elevation from the specified elevation as shown on the drawings shall be as specified below, taken from ACI 117:
 1. Slab-on-Grade Construction - + 3/4".
 2. Top surfaces of all other slabs - + 3/4".
- C. The tolerance on relative elevation difference between points on the floor shall be defined by the FL Levelness F-Number as prescribed below.
- D. Random Traffic Floor Finish Tolerances:
 1. Specified overall values for flatness (SOFF) and levelness (SOFL) shall conform to the values listed below for the floor surface classification noted for each slab category noted.
 - a. SOFF SOFL

1) Conventional	20	15
2) Moderately Flat	25	20
3) Flat	35	25
4) Very Flat	45	35
5) Super Flat	60	40
 2. Minimum local values for flatness (MLFF) and levelness (MLFL) shall equal 3/5 of the SOFF and SOFL values, respectively, unless noted otherwise. The MLFF and MLFL values shall apply to the minimum areas bounded by the column lines and half-column lines, or the minimum areas bounded by the construction and contraction joints, whichever are the smaller areas.
 3. The SOFL and MFLL tolerance values shall apply only to level slabs-on-ground. The Levelness tolerance numbers shall not apply to unshored slabs that deflect under self-weight.
 4. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10 feet at any point.
- E. Construction Requirements to Achieve Specified Floor Finish Tolerances:

1. Forms shall be properly leveled, in good condition and securely anchored including special attention to ends and transitions.
 2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.
 3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.
 4. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.
- F. Contractor Responsibility for Concrete Floor Finish Requirements: Floor finish requirements shown below (flatness and levelness tolerances) are minimum requirements that apply unless stricter requirements are contained in instructions for installation of applied floor products in which case the Contractor is responsible for attaining the values prescribed by the manufacturer of such products.
- G. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:
1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
 2. Finish Tolerances of Random Traffic Floor Surfaces:
 - a. Slabs in nonpublic areas, mechanical rooms, surfaces to receive raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures:
 - b. Conventional
 - c. Carpeted Areas: Moderately Flat
 - d. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat
- H. Concrete Floor Finish Tolerance - Unshored Metal Deck on Shored or Unshored Steel Beam or Open-Web Joist Floor Construction:
1. Concrete Placement: Concrete over metal deck shall be placed and screeded level and flat to the tolerance specified below, maintaining at least the minimum slab thickness at all locations as specified on the drawings. The Contractor shall increase the slab thickness as required to compensate for metal deck deflection, and in unshored beam construction, beam deflection in excess of actual beam camber in order to achieve a level and flat floor within specified tolerances.
 2. Finish Tolerance of Random Traffic Floor Surfaces:
 - a. Slabs in nonpublic areas, mechanical rooms, surfaces to receive raised computer flooring, surfaces to have thick-set tile or a topping, and parking structures: Conventional
 - b. Carpeted Areas: Moderately Flat
 - c. Exposed slabs in public spaces, slabs to receive thin-set flooring: Flat
 - d. Eighty percent (80%) of the final floor surface shall fall within an envelope of 0.75" centered about the mean elevation of all the readings. (± 0.375 about mean). The mean elevation of all readings shall not deviate from the specified design grade by more than ± 0.375 ".
 3. Extra Concrete: The contractor shall include in his bid any additional concrete required to achieve the specified slab surface finish tolerance and to compensate for metal deck deflection, and for beam deflection in excess of actual beam camber.
- I. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:
1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:
 - a. The composite overall values of FF or FL of the entire floor installation measure less than specified values.
 - b. Any individual test section measures less than the specified absolute minimum FF or FL value.
 2. Modification of Existing Surface:

- a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
 - b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair and time to affect the repair.
 - c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning), planning, retopping with self leveling underlayment compound or repair topping, or any combination of the above.
 - d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
 - e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
 - f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.
3. Removal and Replacement:
 - a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
 - b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
 - c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.
 - d. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
 - e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
 - f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
 - g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.18 CONCRETE CURING AND PROTECTION

- A. General:
 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete. Apply evaporation retarder if hot, dry and windy weather causes rapid moisture loss exceeding 0.2 lb./sq. ft. x hr before and during finishing operations. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
 2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be 7 days for all concrete except high early strength concrete which shall be cured for 3 days minimum. Alternatively, curing times may be reduced if either of the following provisions is complied with:

- a. If tests are made of cylinders kept adjacent to the structure and cured by the same methods, curing measures may be terminated when the average compressive strength has reached 70% of the specified 28 day compressive strength.
 - b. If the temperature of the concrete is maintained at a minimum of 50°F for the same length of time required for laboratory cured cylinders of the same concrete to reach 85% of the 28 day compressive strength, then curing may be terminated thereafter.
 3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period.
- B. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by one or a combination of the methods specified below, as applicable.
1. Basement Walls, Sides of Exterior Retaining Walls: Moist cure in forms or by one or a combination of methods 1, 2 or 3 specified below. Use a liquid membrane-forming dissipating resin curing compound conforming to ASTM C 309, type 1, class A or B for method 3.
- C. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping and other flat surfaces by one or a combination of the methods specified below, as applicable. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.
1. Floors Directly Exposed to Vehicular or Foot Traffic not in Parking Areas and not otherwise receiving a chemical hardener or penetrating sealer finish: Apply two coats of a high-solids, water-base, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C1315, type 1, Class A in accordance with method 3 as specified below.
 2. Floors in Non-Public spaces that are left exposed to view and not receiving sealers or hardeners, floors involved in under-floor air distribution systems: Apply one coat of a high-solids, water-based, non-yellowing, liquid membrane-forming curing and sealing compound conforming to ASTM C 1315, type 1, Class A or B in accordance with method 3 as specified below.
 3. Floors that are to receive subsequent cementitious toppings, sealers, hardeners, ceramic tile, vinyl composition tile, or other coating or finishing products: Cure using methods as specified below.
 4. All Other Surfaces: Cure using methods 1, 2, or 3 as specified below. Use a water- based dissipating resin type curing compound conforming to ASTM C 309, type 1, class A or B for method 3.
- D. Curing Methods
1. Method 1 - Moisture Curing: Provide moisture curing by one of the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 2. Method 2 - Moisture-Retaining Cover Curing: Provide moisture-retaining cover curing as follows:
 - a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Water may be added to concrete surface to prevent drying before the cover is installed, but the surface shall not be flooded with water if a non- absorptive cover is used.
 3. Method 3 – Curing or Curing and Sealing Compound: Provide curing, curing/hardener, liquid membrane-forming curing, or curing and sealing compound as follows:

- a. Apply specified compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply second coat for sealing 2 to 3 hours after the first coat was applied.
- b. Do not use membrane-forming curing and sealing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic tile, vinyl composition tile, or adhesive, paint or other coatings and finish materials., Dissipating resin type cures are acceptable in these locationsu

3.19 HOT OR OTHER ADVERSE WEATHER CONCRETING

- A. Definition:
 1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. If conditions cause an evaporation rate of 0.2 lb./sq. ft./hr. as calculated by Figure 2.1.5 in ACI 305R-99, then precautions shall be taken to prevent plastic shrinkage cracks from occurring.
 2. The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.
- B. Specification: Follow hot weather concreting practices specified below when required to limit the concrete temperature at the truck discharge point to the stated maximum acceptable temperature.
- C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature at truck discharge and general weather conditions.
- D. Hot Weather Concreting Requirements: The following items, all or in part as required, shall be followed to limit the concrete temperature to the stated maximum acceptable temperature and to minimize the possibility of plastic shrinkage cracks from developing.
 1. Design the concrete mixes specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using a water reducing retarding admixture (ASTM C 494 Type D).
 2. Use the largest size and amount of coarse aggregate compatible with the job.
 3. Use sunshades and/or windbreaks.
 4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
 5. Cool and shade aggregate stockpiles.
 6. Use ice as part of the mixing water or cool the water with liquid nitrogen.
 7. Limit the number of revolutions at mixing speed to 125 maximum.
 8. Reduce time between mixing and placing as much as possible.
 9. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
 10. Schedule concrete placement for early morning, late afternoon, or night.
 11. Have all forms, equipment and workers ready to receive and handle concrete.
 12. Maintain one standby vibrator for every three vibrators used.
 13. Keep all equipment and material cool by spraying with water including exteriors of forms, reinforcing steel, subgrade, chutes, conveyors, pump lines, tremies, and buggies.
 14. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) in lieu of the water-reducing admixture (Type A) as directed by the Owner's Testing Laboratory.
 15. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 1315. Continue curing for 3 days minimum.

16. Cover reinforcing steel with water soaked burlap so that steel temperature will not exceed ambient air temperature immediately before placement of concrete.
17. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

3.20 COLD OR OTHER ADVERSE WEATHER CONCRETING

- A. Definition:
 1. Concrete shall not be placed when the outside air temperature is 40°F or less unless cold weather concreting practices are followed as specified below.
 2. Cold weather concreting practices should also be followed whenever the average daily air temperature is less than 40°F for more than three successive days. The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight. The requirement for adhering to these cold-weather concreting practices may be terminated when the air temperature is above 50° F for more than half of any 24h duration.
 3. The temperature of the concrete immediately after placing shall be no less than and no more than 20° greater than the following temperature:
 - a. 55° F for sections less than 12 in. in the least dimension
 - b. 50° F for sections 12 to 36 in. in the least dimension
 - c. 45° F for sections 36 to 72 in. in the least dimension
 - d. 40° F for sections greater than 72 in. in the least dimension
 4. Protect the concrete immediately after placing and during the curing period such that the concrete does not freeze nor fall below the temperature levels stated in the above paragraph. When removing protection, the maximum decrease in temperature measured at the surface of the concrete in a 24 hour period shall not exceed the following:
 - a. 50° F for sections less than 12 in. in the least dimension
 - b. 40° F for sections 12 to 36 in. in the least dimension
 - c. 30° F for sections 36 to 72 in. in the least dimension
 - d. 20° F for sections greater than 72 in. in the least dimension
 5. The maximum concrete temperature heated by artificial means at point of placement shall not exceed 90°F.
- B. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed and general weather conditions.
- C. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:
 1. Design the concrete mix suitable for cold weather. Use air entrainment (where not prohibited) and obtain high early strength by using a higher cement content, a high early strength cement (Type III), or a specified non-chloride accelerator (ASTM C 494 Type C or E).
 2. Protect the concrete during curing period using insulating blankets, insulated forms, enclosures and/or heaters.
 3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
 4. Frozen subgrade shall be thawed prior to concrete placement and snow and ice shall be removed from forms.
 5. Concrete shall be protected and cured at 50°F for seven days minimum if normal concrete (Type I cement) is used and for three days minimum if high early strength concrete (concrete with Type III cement, 100 pounds cement added per cubic yard concrete, or a non-chloride accelerator added).
 6. Concrete not loaded during construction shall be protected a minimum of 3 days for normal concrete and 2 days for high early strength concrete to obtain safe form stripping strength. Concrete fully loaded during construction shall be protected for whatever time period is required to obtain the required strength as determined by nondestructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete.

7. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
8. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F in order to prevent flash set of the concrete.
9. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
10. Cover warmed stockpiles with tarps to retain heat.
11. Place air entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
12. Use wind screens to protect concrete from rapid cooling.
13. Place vertical pump lines inside the building, if possible, for concrete being pumped.
14. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
15. Avoid water curing of concrete except for parking garage structures. Apply the required curing compound to unformed surfaces as soon as possible to prevent drying of concrete from heated enclosures.
16. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
17. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
18. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
19. Gradually reduce the heat at the end of the heating period to reduce likelihood of thermal shock.

3.21 SHRINKAGE AND TEMPERATURE REINFORCEMENT

- A. Provide shrinkage and temperature reinforcement (as required by ACI 318) at right angles to main top and bottom bars for all structural slabs unless detailed otherwise on the drawings.

3.22 PLACEMENT OF WELDED WIRE FABRIC

- A. Wherever welded wire fabric is specified as reinforcement in slabs, it shall be continuous and properly lapped one full wire spacing plus 2" across the entire concrete surface and not interrupted by beam or girders.

3.23 PLACEMENT OF COLUMN DOWELS AND ANCHOR RODS

- A. Dowels for columns, plinths, and pilasters and anchor rods shall be accurately set using 1/8" thick steel templates.

3.24 REINFORCEMENT IN COMPOSITE METAL DECK SLAB

- A. Composite metal deck slabs shall be reinforced as indicated on the drawings.
- B. Extra Reinforcement Over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.
- C. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the details.

3.25 REINFORCEMENT AROUND OPENINGS IN COMPOSITE METAL DECK SLAB

- A. For all openings in metal deck not framed with structural steel and greater than 10" in width in either direction, provide additional reinforcing steel as shown in details on the drawings.

3.26 REINFORCEMENT IN GRADE BEAMS

- A. Provide reinforcing in grade beams as shown on the drawings.

- B. Bar Support for Grade Beam Cages: Grade beam bottom steel shall be supported at 5'-0" maximum centers using beam bolsters that provide 3" bottom cover to the reinforcing steel. Beam bolsters used shall be designed and manufactured for support on soil.

3.27 REINFORCEMENT IN HOUSEKEEPING PADS

- A. Provide welded smooth wire fabric 6 x 6 W2.9 x W2.9 minimum in all housekeeping pads supporting mechanical equipment unless detailed otherwise on the drawings.

3.28 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 corners, 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. Installation of Adhesive Anchors Using Injectable Epoxy or Adhesive: A representative of the adhesive manufacturer shall be present for the first three holes that are drilled and filled with adhesive. After drilling the hole to the diameter and depth recommended by the manufacturer, clean the hole with a wire or nylon brush. Blow the dust out of the hole using compressed air with a nozzle that reaches to the bottom of the hole. When using adhesive from a new pack, the adhesive that is discharged from the mixing nozzle should be a uniform gray color before any adhesive is installed in the hole. Fill the hole with adhesive starting from the very bottom of the hole until the hole is about 2/3 full. Do not leave an air pocket at the bottom of the hole. Insert the anchor rod or dowel by slowly twisting it into the hole.

3.29 CONCRETE SURFACE REPAIRS

- A. Definition - Defective Areas:
1. Formed Surfaces: Concrete surfaces requiring repairs shall include all honeycombs, rock pockets and voids exceeding 1/4" in any dimension, holes left by tie rods or bolts, cracks in excess of 0.01" and any other defects that affect the durability or structural integrity of the concrete.
 2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks in excess of 0.01" wide or cracks which penetrate to reinforcement or through the member, popouts, spalling and honeycombs.
- B. Classification:
1. Structural Concrete Repair: Major defective areas in concrete members that are load carrying (such as shear walls, beams, joists and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two part epoxy bonder, epoxy mortar or specified polymer repair mortar. Location of structural concrete repairs shall be determined by the Engineer.
 2. Cosmetic Concrete Repair: Defective areas in concrete members that are non-load carrying and minor defective areas in load carrying concrete members shall require cosmetic concrete repair when exposed to view and not covered up by architectural finishes. Cosmetic concrete repairs may be made using a polymer repair mortar and compatible bonding agent. The location of cosmetic concrete repair required shall be determined by the Architect/Engineer. Stains and other discolorations that cannot be removed by cleaning and are exposed to view will require cosmetic repair. Cosmetic concrete repair in exposed-to-view surfaces will require Architect's approval prior to patching operation.

3. Slab Repairs: High and low areas in concrete slabs shall be repaired by removing and replacing defective slab areas unless an alternate method, such as grinding and/or filling with self-leveling underlayment compound or repair mortar is approved by the Architect/Engineer. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer. The high strength flowing repair mortar may be used for areas greater than 1 inch in depth.

3.30 QUALITY ASSURANCE TESTING AND INSPECTION DURING CONSTRUCTION

- A. The Owner will engage a special inspector and qualified testing and inspection agency (the Owner's Testing Laboratory) to perform field tests and inspections and prepare test reports.
- B. Special Inspections:
 1. Verification of use of required design mixture
 2. Concrete placement, including conveying and depositing
 3. Curing procedures and maintenance of curing temperatures
 4. Verification of concrete strength before removal of shores and forms from beams and slabs.
 5. Steel reinforcement placement. Inspect 100% of reinforcement before each concrete pour to verify the information noted below:
 - a. Primary and secondary, longitudinal reinforcement has correct size and number in proper layers.
 - b. Longitudinal reinforcement has correct length and lap.
 - c. Ties and stirrups are of correct size, spacing, and number and have the proper termination-hook geometry.
 - d. Unscheduled face reinforcement in beams are provided and are of correct size, number and spacing and have the proper end terminations.
 - e. Proper hooks are provided at bar ends as detailed.
 - f. Reinforcement is properly supported and braced to formwork to prevent movement during concreting operation.
 - g. Reinforcement has proper cover.
 - h. Sufficient spacing between reinforcement for concrete placement.
 - i. Dowel reinforcement is of proper size, at proper spacing, and has proper lap length and embedment length.
 - j. Welded wire reinforcement is composed of flat sheets, has proper wire gage and spacing, is properly supported, and is properly lapped with a length of one square plus two inches.
 - k. Proper Construction/Contraction/Expansion joint spacing and reinforcement.
 - l. Reinforcement around embedded items is erected according to details.
 - m. Proper installation of flat-slab shear-head reinforcement
 6. Steel reinforcement welding: Periodic inspection of the welding of reinforcing bars to assure compliance with the requirements of AWS.
- C. Concrete Mix Designs: The Owner's Testing Laboratory shall review the submitted mix designs for conformance to the specifications and for suitability for use in the project. The Testing Laboratory shall attend the Mix Design Conference and the Pre-Concrete Conference as noted in the Cast-in-Place Concrete Specification.
- D. Concrete Tests:
 1. Field Sampling: Obtain field samples for testing in accordance with ASTM C 172.
 2. Frequency of Testing: Obtain a sample of concrete for testing according to the following minimum frequency guidelines:
 - a. One sample for each class of concrete taken not less than once a day at a minimum.
 - b. Underreamed Footings: One sample for each 50 cubic yards or fraction thereof.
 - c. Spread Footings and Pier Caps: One sample for each 50 cubic yards or fraction thereof.

- d. Floors: One sample for each 150 cubic yards or fraction thereof but not less than one sample for each 5000 square foot of floor area.
- e. All Other Concrete: A minimum of one sample for each 150 cubic yards or fraction thereof.
- f. No more than one sample at a time shall be made from any single truck.
- g. If the total volume of concrete is such that the frequency of testing as specified above would provide less than five samples for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five batches are used.
- h. The above frequencies assume that one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.
- 3. Slump Tests: Slump Tests (ASTM C 143) shall be made at the beginning of concrete placement for each batch plant and for each sample taken. The slump test shall be made from concrete taken from the end of the concrete truck chute. Perform additional tests when concrete consistency appears to change.
- 4. Air Content: Air content tests (ASTM C 231 or C 173, C 173 only for lightweight concrete) shall be made for each sample taken.
- 5. Concrete Temperature: Concrete temperature at placement shall be measured (ASTM C 1064) for each sample taken and once each hour when air temperature is 40 degrees F and below and when 80 degrees F and above.
- 6. Unit Weight: Tests to measure fresh unit weight of structural lightweight concrete (ASTM C 567) shall be made for each concrete sample taken.
- 7. Compressive-Strength Tests: Cast and laboratory cure a set of cylinder specimens in accordance with ASTM C 31 and test for compressive strength in accordance with ASTM C 39. Each set of test cylinders shall consist of a minimum of four 6" x 12" standard test cylinders or five 4" x 8" test cylinders cast from each sample taken. The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded.
 - a. For concrete specified on the drawings to reach the required strength at 28 days, break one of the cylinders of the set at seven days, two 6"x 12" cylinders or three 4" x 8" cylinders at 28 days, and one at 56 days.
 - b. Additional Cylinder for Floor Form Stripping: If concrete strength for form stripping is to be determined using field-cured cylinders, one additional cylinder per set will be required for formed slab and pan joist floors for the purpose of evaluating the concrete strength at the time of form stripping. This cylinder shall be stored on the floor where form removal is to occur under the same exposure conditions as the floor concrete. The cylinder shall be cured under field conditions in accordance with ASTM C 31. Field cured test cylinders shall be molded at the same time and from the same samples as Laboratory cured test specimens. The cylinder shall be broken at the time of form removal as directed by the Contractor. The Contractor shall reimburse the Owner for the cost of making and testing these cylinders.
 - c. Cylinder Storage Box: The Contractor shall be responsible for providing a
 - d. protected concrete cylinder wooden storage box at a point on the job site mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory. The box shall be constructed and equipped to maintain the environment specified for initial curing in ASTM C 31.
 - e. Transporting Cylinders: The Owner's Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders including loss of moisture, freezing temperatures or jarring.
- 8. Information on Concrete Test Reports: The Owner's Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:
 - a. Truck number and ticket number
 - b. Concrete Batch Plant

- c. Mix design number
 - d. Accurate location of pour in the structure
 - e. Strength requirement
 - f. Date cylinders made and broken
 - g. Technician making cylinders
 - h. Concrete temperature at placing
 - i. Air temperature at point of placement in the structure
 - j. Amount of water added to the truck at the batch plant and at the site and whether or not it exceeds the amount allowed by the mix design
 - k. Slump
 - l. Unit weight (when noted as required)
 - m. Air content
 - n. Cylinder compressive strengths (the average strength of the two cylinders from each set tested at the time indicated above). Note the type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be flagged if either cylinder fails to meet Specification requirements.
- E. Evaluation and Acceptance of Concrete: The Owner's Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:
- 1. Number of strength tests made to date.
 - 2. Strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
 - 3. Number of tests under specified strength.
 - 4. A histogram plotting the number of strength test cylinders versus compressive strength.
 - 5. Quality control chart plotting compressive strength test results for each test.
 - 6. Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
 - 7. Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.
- F. Concrete Batch Plant Inspection: An initial batch plant inspection shall be made by the Owner's Testing Laboratory prior to the start of concrete work. The scope of batch plant inspection shall include the following:
- 1. Inspection of Batch Plant Facilities: The Laboratory shall inspect batch plant facilities proposed for use in the work and report in writing inspection results to the Architect, Engineer, and Owner for approval. The inspection shall confirm the batch plant conforms to the standards set forth in ASTM C 94 and can show proof of certification by the National Concrete Ready Mix Association. Inspection shall include:
 - a. Batch Plant operations and equipment
 - b. Truck mixers
 - c. Scales
 - d. Stockpile placement
 - e. Material storage
 - f. Admixture dispensers
 - 2. Multiple Batch Plants: The Contractor shall reimburse the Owner for the costs accrued to the Owner's Testing Laboratory for visits to more than 1 batch plant.
- G. The following inspections shall be performed by the Owner's Testing Laboratory or Special Inspector as applicable:
- 1. Prior to Concrete Placing
 - a. Spread Footings
 - (1) Verify footing dimension.
 - (2) Verify top of footing elevation.

- (3) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 - (4) Inspect reinforcement per REINFORCING STEEL section.
 - b. Grade Beams
 - (1) Verify width, depth and elevation of grade beams.
 - (2) Verify that forms are plumb and straight, braced against movement, and lubricated for removal.
 - (3) Verify that carton forms below grade beam are dry.
 - (4) Verify that carton forms are neatly formed around piers.
 - (5) Inspect reinforcement per REINFORCING STEEL section.
 - c. Slab-on-Grade
 - (1) Verify that moisture retarder is provided, is lapped properly, and is not torn or punctured.
 - (2) Verify formwork at turndowns and slab edges is plumb and straight, braced against movement and lubricated for removal.
 - (3) Inspect reinforcement per REINFORCING STEEL section.
 - (4) Verify there is no standing water or debris in pour area.
2. On-Site Concrete Material Testing and Inspection
- a. Verify that the Contractor is following appropriate concreting practices consistent with any extreme environmental conditions at the point of placement in the structure as defined below.
 - b. Inspect concrete upon arrival to verify that the proper concrete mix number, type of concrete, and concrete strength is being placed at the proper location.
 - c. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. Record the amount of water added and note if it exceeds that allowed in the mix design. The responsibility for adding water to trucks at the job site shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
 - d. Obtain concrete test cylinders.
 - e. Perform tests to determine slump, concrete temperature, unit weight, and air entrainment. The slump tests shall be made on concrete taken from the same location from which the concrete for the test cylinders is obtained.
 - f. Record information for concrete test reports.
 - g. Verify that concrete being placed meets job Specifications. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Architect, Engineer, and Owner.
 - h. Pick up and transport to Laboratory, cylinders cast the previous day.
3. During concrete placing, provide continuous monitoring to:
- a. Verify that the concrete is not over 90 minutes old at the time of placement.
 - b. Verify that Hot-Weather or Cold-Weather techniques are being applied as required.
 - c. Verify that concrete deposited is uniform and that vertical drop does not exceed six feet and is not permitted to drop freely over reinforcement causing segregation.
 - d. Verify that there are no cold joints.
 - e. Verify that the concrete is properly vibrated.
 - f. Verify that the finishing of the concrete surface is done according to specifications.
 - g. Verify that the curing process is according to specifications and that any curing compound used is applied in accordance with manufacturer's recommendations.
 - h. Verify that sawcut control joints on slab-on-grades are cut within 12 hours of placement.
 - i. Verify that the formwork has remained stable during the concreting operation.
4. In-situ Concrete Strength Verification: The Owner's Testing Laboratory shall verify that the concrete has reached the required minimum strength before form removal by evaluating the specified tests.

5. The job site inspector shall report any irregularities that occur in the concrete at the job site or test results to the Contractor, Architect, Owner, and Engineer.

3.31 INVESTIGATION OF LOW CONCRETE STRENGTH TEST RESULTS

- A. Contractor Responsibility for Low Strength Concrete
 1. If the average of any three consecutive strength tests falls below the required f'_c for a class of concrete but no individual strength test is more than 500 psi below f'_c , the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to increase the average of subsequent strength tests.
 2. If any individual strength test falls more than 500 psi below the required f'_c , the Contractor shall immediately notify the Engineer by telephone or e-mail and take immediate steps to assure that the load-carrying capacity of the structure is not jeopardized.
- B. Additional Field Tests to Confirm Low Concrete Strengths
 1. The cost of all investigations of low-strength concrete, as defined by any individual strength test being more than 500 psi below the required f'_c , shall be borne by the Contractor.
 2. Code-Prescribed Acceptance: The only accepted field-test methods of determining actual in-situ concrete strength is by the way of core tests as prescribed below.
 3. Non-Destructive Tests: If any individual strength test falls more than 500 psi below the required f'_c , the Engineer may request that non-destructive field tests be performed on the concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer. Report the comparative test results of the suspect concrete under consideration with identical tests done on concrete of known strength and of the same class. The Engineer considers these test results as only approximate indicators of strength and may not necessarily, by themselves, resolve the low concrete strength issue. These test results will be considered as additional information by which to make an informed judgment. The Engineer reserves the right to accept the concrete based on the results of these approximate tests or order that core tests be taken as prescribed below. At the Contractor's option, the approximate non-destructive field-tests may be waived and core tests immediately initiated.
 4. Core Tests: If, in the opinion of the Engineer, the likelihood of low-strength concrete is confirmed and it has been determined that the load-carrying capacity of the structure is significantly reduced as a result, the Engineer may request that core tests be taken from the area in question as directed by the Engineer. There shall be a minimum of three cores taken for each strength test more than 500 psi below the required f'_c and tested in accordance with ASTM C 42. If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for 7 days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 48 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.
 5. Acceptance Criteria for Core Test: Concrete in an area represented by core tests shall be considered adequate if the average of three cores is equal to at least 85% of the required f'_c and no single core is less than 75% of the required f'_c . If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.
 6. Load Test: If the concrete strength is not considered adequate based on core tests and the structural adequacy remains in doubt, the Engineer may order a load test as specified in ACI 318 be conducted for the questionable portion of the structure.
 7. Strengthening of the Structure or Demolition: If the structural adequacy of the affected portion of the structure remains in doubt following the load test, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt at the Contractor's expense.

END OF SECTION

SECTION 03 3500
POLISHED CONCRETE FINISHING

POLISHED CONCRETE FINISHING

1.01 SECTION INCLUDES

- A. Polished concrete.

1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. American Concrete Institute (ACI): ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- B. American National Standards Institute (ANSI): Standards B-101.1/2009.
- C. ASTM International (ASTM):
 - 1. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 3. ASTM C 779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- D. Reunion Internationale des Laboratoires D'Essais et de Recherches sur les Materiaux et les Constructions (RILEM): Rilem Test Method 11.4 - Standard Measurement of Reduction of Moisture Penetration through Horizontal Concrete Surfaces.
- E. National Floor Safety Institute (NFSI): NFSI Test Method 101-A - Standard for Evaluating High-Traction Flooring Materials.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide polished flooring that has been designed, manufactured and installed to achieve the following:
 - 1. Abrasion Resistance: ASTM C779, Method A, high resistance, no more than 0.008 inch (0.20 mm) wear in 30 minutes.
 - 2. Reflectivity: Increase of 35% as determined by standard gloss meter.
 - 3. Waterproof Properties: Rilem Test Method 11.4, 70% or greater reduction in absorption.
 - 4. High Traction Rating: NFSI 101-A, ANSI B-101.1 2009 non-slip properties.
- B. Design Requirements:
 - 1. Hardened Concrete Properties:
 - a. Minimum Concrete Compressive Strength: 3500 psi (24 MPa).
 - b. Normal Weight Concrete: No lightweight aggregate.
 - c. Non-air entrained.
 - 2. Placement Properties:
 - a. Natural concrete slump of 4-1/2 inches to 5 inches (114 to 127 mm). Admixtures may be used.
 - b. Flatness Requirements:
 - 1) Overall FF 50.
 - 2) Local FF 40.
 - 3. Hard-Steel Troweled (3 passes) Concrete: No burnishing marks. Finish to ACI 302.1R, Class 5 floor.
 - a. Class 6 floors, special colored mineral aggregate hardener with repeated hard steel trowel finish.
 - 4. Curing Options:
 - a. Membrane forming curing compounds (ASTM C309, Type 1, Class B, all resin, dissipating cure). 1) Acrylic curing and sealing compounds not recommended.
 - b. Sheet membrane (ASTM C171); polyethylene film not recommended.

- c. Damp Curing: Seven day cure.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 3000 - Administrative Requirements.
- B. Shop Drawings: Indicate information on shop drawings as follows:
 1. Typical layout including dimensions and floor grinding schedule.
 2. Plan view of floor and joint pattern layout.
 3. Areas to receive colored surface treatment.
 4. Hardener, sealer, densifier identified in notes.
- C. Product Data: Submit product data, including manufacturer's SPEC-DATA product sheet, for specified products.
 1. Material Safety Data Sheets (MSDS).
 2. Preparation and concrete grinding procedures.
 3. Colored Concrete Surface, Dye Selection Guides.
- D. Quality Assurance Submittals:
 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties as cited in Performance Requirements.
 2. Certificates:
 - a. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - b. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed phase Two Level of certification when tested by Method 101-A. ANSI B-101.1 2009 non-slip properties.
 - c. Current contractor's certificate signed by manufacturer declaring Contractor as an approved installer of polishing system.
 3. Manufacturer's Instructions: Manufacturer's installation instructions.
- E. Warranty: Submit warranty documents specified.
- F. Operation and Maintenance Data: Submit operation and maintenance data for installed products.
 1. Manufacturer's instructions on maintenance renewal of applied treatments.
 2. Protocols and product specifications for joint filling, crack repair and/or surface repair.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer with a minimum of 5 years' experience in performing work of this section who has specialized in installation of work similar to that required for this project.
 2. Installer trained and holding a current certificate as a FGS PermaShine installer.
 3. Current Certification from the CPAA stating that the technicians are trained craftsmen.
- B. Concrete finishing components and materials shall be from single manufacturer.
- C. Manufacturer Qualifications:
 1. Manufacturer capable of providing field service representation during construction and approving application method.
 2. Manufacturer shall have a minimum 5 years of experience in manufacturing components similar to or exceeding requirements of project.
- D. Regulatory Requirements: Comply with NFSI Test Method 101-A Phase Two Level High Traction Material.
- E. Mock-Ups:
 1. Mock-Up Size: 100 sf (9.3 m²) sample panel at jobsite at location as directed under conditions similar to those which will exist during actual placement.
 2. Mock-up will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application, color selection and shine.
 3. Allow 24 hours for inspection of mock-up before proceeding with work.

4. When accepted, mock-up will demonstrate minimum standard of quality required for this work.
 - a. Approved mock-up may not remain as part of finished work. Remove mock-up and dispose of materials when no longer required and when directed by Architect.
 - b. Approved mock-up may remain as part of finished work.
5. Mock-Up will demonstrate required level of cut:
 - a. Level 1 - Cream Finish: Polishing only the Portland Cement paste at the surface without exposing small, medium or large aggregate. Note: If dye will be used, this is not an acceptable level of grinding. Go to Level 2.
 - b. Level 2 - Salt/Pepper Finish: Expose the fine aggregate such as sand and small aggregate with the concrete. The depth of grind will depend greatly on the placement and finishing procedures. Generally, this level of cut can be achieved within 1/16" of the surface.
 - c. Level 3 - Medium Aggregate: Exposing more of the overall girth of the coarse aggregate within the concrete. Generally, this level of cut can be achieved within 1/8" of the surface.
 - d. Level 4 - Large Aggregate: Exposing the overall girth of the coarse aggregate within the concrete. This level of cut generally can be achieved within 1/4" of the surface.
 - e. Sheen Level A: Sheen (glossy) as determined by a gloss reading of 45 - 60.
 - f. Sheen Level B: Sheen (high gloss) as determined by a gloss reading of 60 - 70.
 - g. Sheen Level C: Sheen (very high gloss) as determined by a gloss reading of 70 or higher.
- F. Pre-installation Meetings: Conduct a pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:
 1. Environmental requirements.
 2. Scheduling and phasing of work.
 3. Coordinating with other work and personnel. Remind all trades that they are working on a surface that is to become a finished surface.
 4. Protection of adjacent surfaces.
 5. Surface preparation.
 6. Repair of defects and defective work prior to installation.
 7. Cleaning.
 8. Installation of polished floor finishes.
 9. Application of liquid hardener, densifier.
 10. Protection of finished surfaces after installation.
 11. placing of materials on the concrete surface that may cause staining, etching or scratching

1.07 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original packaging with identification labels and seals intact.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Protect Concrete Slab:
 1. Protect from petroleum stains during construction.
 2. Diaper hydraulic power equipment.

3. Restrict vehicular parking.
 4. Restrict use of pipe cutting machinery.
 5. Restrict placement of reinforcing steel on slab.
 6. Restrict use of acids or acidic detergents on slab.
- C. Waste Management and Disposal:
1. Separate waste materials for Reuse and Recycling in accordance with Section 01 74 19 - Construction Waste Management and Disposal.
 2. Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.09 PROJECT AMBIENT CONDITIONS

- A. Installation Location: Comply with manufacturer's written recommendations.

1.10 SEQUENCING

- A. Sequence with Other Work: Comply with manufacturer's written recommendations for sequencing construction operations.

1.11 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: L&M Construction Chemicals, which is located at: 1 LATICRETE Park N.; Bethany, CT 06524-3423; Toll Free Tel: 800-362-3331; Tel: 402-453-6600; Email: request info (info@lmcc.com); Web: www.laticrete.com/lmcc
- B. Substitutions: Not permitted.

2.02 POLISHED CONCRETE

- A. Products/Systems:
1. Hardener, Sealer, Densifier: Proprietary, water based, odorless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., FGS Hardener Plus. Basis of design.
 2. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing, polyurea control joint and crack filler with Shore A 80 or higher hardness.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., Joint Tite 750.
 3. Oil Repellent Sealer: Ready to use, silane, siloxane and fluoropolymers blended water based solution sealer, quick drying, low-odor, oil and water repellent, VOC compliant and compatible with chemically hardened floors.
 - a. Acceptable Material: L & M Construction Chemicals, Inc., Petrotex.
 4. Cleaning Solution: Proprietary, mild, highly concentrated liquid concrete cleaner and conditioner containing wetting and emulsifying agents; biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI).
 - a. Acceptable Material: L & M Construction Chemicals, Inc., FGS Concrete Conditioner.
 5. Stain Guard Sealer: Ready to use, is a low odor, VOC compliant, topical sealer consisting of low molecular emulsified cross-linking, coupling polymers that effectively protect concrete and other natural stone floor surfaces from the damaging effects of staining, defacing and deterioration due to contaminant penetration.
 - a. Acceptable Material: L& M Construction Chemicals, Inc. Permaguard SPS.
 6. Finish: Medium gloss (MG-2), 800.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:

1. Verify that concrete substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete finishing materials.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify Concrete Slab Performance Requirements:
 1. Verify concrete is cured to 28 day duration and 3500 psi (24 MPa) strength.
 2. Verify concrete surfaces have received a hard steel-trowel finish (3 passes) during placement.
 3. Verify overall floor flatness is a minimum of Ff 40.

3.02 PREPARATION

- A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of concrete finishing materials.
- B. Examine surface to determine soundness of concrete for polishing.

3.03 INSTALLATION

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions.
- B. Floor Surface Polishing and Treatment:
 1. Provide polished concrete floor treatment in entirety of slab indicated by drawings. Provide consistent finish in all contiguous areas.
 2. Apply floor finish prior to installation of fixtures and accessories.
 3. Diamond polish concrete floor surfaces with power disc machine recommended by floor finish manufacturer. Sequence with coarse to fine grit. Installer to determine the optimum starting grit in order to achieve the specified aggregate exposure.
 - a. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Following the initial passes of metal bond diamonds, the installer shall drop back a minimum of one grit level when transitioning to resin bond diamonds. The separation in grit designation shall be a minimum of 50 for the transitioning step. The installer shall refine each abrasive grit to its fullest potential before moving on to the next level. Floor shall be thoroughly scrubbed between each grit pass to remove all loose material. Level of sheen shall match that of approved mock-up.
 - b. Expose aggregate in concrete surface only as determined by approved mock-up.
 - c. All concrete surfaces shall be as uniform in appearance as possible.
 4. Dyed and Polished Concrete:
 - a. ~~Locate demarcation line between dyed surfaces and other finishes.~~
 - b. Polish concrete to the 400 grit level, ~~(200 grit for water based dyes).~~
 - c. ~~Apply pre-mixed dyes to polished concrete surface.~~
 - d. ~~Allow dye to dry.~~
 - e. Remove residue with water and buffer pad; reapply as necessary for desired result.
 5. Hardener and Densifier Application:
 - a. First coat of FGS Hardener Plus at 250 ft²/gal (6.25 m²/L), following the 400 grit level. (Lion Hard at 400-600 sq ft / gallon).
 - b. Second coat of FGS Hardener Plus at 350 ft²/gal (8.75 m²/L), prior to the final polishing pass (Lion Hard at 600-800 sq ft / gallon).
 - c. Follow manufacturer's recommendations for drying time between successive coats.
 6. Remove defects and re-polish defective areas.
 7. Finish edges of floor finish adjoining other materials in a clean and sharp manner.

3.04 ADJUSTMENTS

- A. Re-polish those areas not meeting specified gloss levels per mock-up.
- B. Fill joints flush to surface prior to the start of polishing operations.

3.05 FINAL CLEANING

- A. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.06 PROTECTION

- A. Protect installed product from damage during construction in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 04 2723
CAVITY WALL UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clay facing brick.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

1.03 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 MOCK-UPS

- A. Construct a masonry cavity wall as a mock-up panel, 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar and accessories, reinforcement, flashings, and wall insulation in mock-up.
- B. Locate facing south.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 UNIT MASONRY - GENERAL

2.02 BRICK UNITS

- A. Manufacturers:
 1. Boral Bricks, Inc: www.boralbricks.com/#sle.
 2. ACME Brick.
 3. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.
- B. Facing Brick: ASTM C216, Type FBS, Grade SW.
 1. Nominal Size: As indicated on drawings.
 2. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 1. Hohmann & Barnard, Inc: www.h-b.com/#sle.
- B. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face.

1. Hohmann & Barnard, Inc X-SEAL Anchor or equal. Corrugated wall ties are not allowed.

2.04 FLASHINGS

- A. Metal Flashing Materials:
 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch (0.48 mm) thick; finish 2B to 2D.
 2. Prefabricated Metal Flashing: Smooth fabricated 12 oz/sq ft (3.66 kg/sq m) stainless steel (type 304) flashing for surface mounted conditions.

2.05 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Weeps: Molded PVC grilles, insect resistant.
- C. Cleaning Solution: Nonacidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units:
 1. Bond: running, unless indicated differently on drawings.
 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Remove excess mortar as work progresses.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in cavity walls at 24 inches (600 mm) on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

3.07 CAVITY WALL CONSTRUCTION

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Build inner wythe ahead of outer wythe to receive accessories.

3.08 LINTELS

- A. Install loose steel lintels over openings.

3.09 CONTROL AND EXPANSION JOINTS

- A. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.10 CLEANING

- A. Remove excess mortar and mortar smears as work progresses.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

3.11 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 06 1000 ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. All rough carpentry items including, but not limited to:
 - 1. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support.
 - 2. Wood cants, nailers, curbs, and other items associated with roofing work.
 - 3. Miscellaneous framing items and plywood sheathing.

1.02 RELATED WORK

- A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's data on wood treatment materials.

1.04 STANDARDS AND GRADING

- A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.
- B. Each piece of plywood used shall carry the American Plywood Association trademark.
- C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.
- D. Reference Standards: Conform with all requirements.
 - 1. S. Dept. of Commerce Product Standards (PS)
 - 2. American Plywood Association (APA)
 - a. Standards and Construction Guide
 - 3. American Wood Preservers Association (AWPA)
 - a. Standards, as they apply.
 - 4. Architectural Woodwork Institute (AWI)
 - a. "Quality Standards"
 - 5. National Woodwork Manufacturers' Association (NWMA)
 - a. Standards
 - 6. Western Wood Products Association (WWPA)
 - a. Manual

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber:
 - 1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
 - a. Comply with NWMA Standards
 - b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.
 - 2. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.

3. Fire Retardant No, 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.
- B. Plywood:
 1. General: Comply with APA Standards.
 2. APA A-D, Group 1 Interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF>IDF closets and telephone boards in mechanical and telephone rooms where shown or required. 3/4 inch thick unless required or shown otherwise. Paint as scheduled in Section 09 91 00.
 3. Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
 4. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
 5. If shown or required, APA rated Stundi-floor, exterior grade, tongue and groove edges.
- C. Rough Hardware:
 1. Nails, Spikes, and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
 2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
 3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.
- D. Wood Treatment:
 1. Preservative Treatment (Concealed Conditions):
 - a. Borate: Pressure impregnate preservative to net retention of 0.28 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards:
 - b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
 - c. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
 - d. Concealed conditions mean conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
 - e. ACQ and CCA preservatives not permitted.
 - f. Acceptable Manufacturers: Osmose "Advance Guard"; Universal Forest Products "Prowood Borate"; or Architect approved equal.
 2. Fire Retardant Treatment:
 - a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
 - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wood Framing:
 1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
 2. Spiking and nailing shall be done using largest size spikes and nail practicable.

3. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
 4. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
 5. Provide blocking, bucks and framing as necessary and for other trades as required.
 6. Drill lumber accurately for bolts and fit all bolts with suitable washers.
- B. Plywood:
1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
 2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

END OF SECTION

**SECTION 06 2000
FINISH CARPENTRY AND MILLWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of:
 - 1. Finish hardware
 - 2. Plastic laminate faced wood doors

1.02 RELATED WORK

- A. Section 08 1423 - Plastic Laminate Faced Wood Doors
- B. Section 08 7100 - Finish Hardware

1.03 SUBMITTALS

- A. Closeout:
 - 1. Record Drawings: indicate revisions to original drawings and shop drawings
 - 2. Manufacturer contact names, addresses and phone numbers.
 - 3. Finish Material Schedule: names and color numbers of laminates and stains.
 - 4. Provide additional master key for each room and additional locksets totaling one percent of total project for attic stock.

1.04 PRE-INSTALLATION CONFERENCE

- A. Section 01 3113 – Project Coordination.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.
- C. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork contractor shall be responsible for hardware on millwork.

3.02 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

- A. Protect all doors during handling.
- B. Refer to Section 08 7100, Finish Hardware for hardware requirements.
- C. Install doors in accordance with manufacturer's instructions.
- D. Install and adjust doors for smooth, quiet operation.

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.
- D. Preparation for site finishing.
- E. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - ROUGH CARPENTRY: Support framing, grounds, and concealed blocking.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware; 2020.
- D. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.

1.04 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches (300 mm) square, illustrating proposed cabinet and countertop substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
- B. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- C. Perform cabinet construction in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 MOCK-UPS

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 SUMMARY

- A. All cabinets are to be provided as detailed and will be plastic laminate clad.

2.02 MANUFACTURERS

- A. Keystone Millwork, Bryan, TX.
- B. Any AWI Certified Manufacturer.
- C. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.
- D. Single Source Responsibility: Provide and install this work from single fabricator.

2.03 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

2.04 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.05 PANEL MATERIALS

- A. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
 1. Use for painted components and concealed components.
 2. Use as backing for plastic laminate unless otherwise indicated.
- B. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch (6 mm) thick, smooth two sides (S2S); use for drawer bottoms, dust panels, and other components indicated on drawings.

2.06 LAMINATE MATERIALS

- A. Manufacturers:
 1. Wilsonart International, Inc: www.wilsonart.com. (Basis of Design)
 2. Formica Corporation[<>]: www.formica.com.
 3. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as indicated.
 1. Cabinet Liner: CLS, 0.020 inch (0.51 mm) nominal thickness, White, textured low gloss finish.

2.07 COUNTERTOPS

2.08 ACCESSORIES

- A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness, color as selected from manufacturer's standards.
- B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

- C. Concealed Joint Fasteners: Threaded steel.
- D. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.09 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch (25 mm) spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
- D. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: As required by drawer size.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide soft closing type.
- E. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
 - 1. Manufacturers:
 - a. Hardware Resources; _____: www.hardwareresources.com/#sle.
 - b. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.10 FABRICATION

- A. Cabinet Style: Flush overlay.
- B. Cabinet Doors and Drawer Fronts: Flush style.
- C. Drawer Construction Technique: As recommended by fabricator.
- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)
 - 1. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- H. Mechanically fasten back splash to countertops with steel brackets at 16 inches (400 mm) on center.
- I. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.
- C. Contractor is responsible for field measurements and to verify all existing conditions before manufacturing products.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.
- E. Secure cabinets and counter bases to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 1400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Masonry joints prepared to receive flashings.
- B. Section 07 2100 - Thermal Insulation: Insulation used for protective cover.

1.03 REFERENCE STANDARDS

- A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
- B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- C. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2020.
- D. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.
- F. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
- B. Product Data: Provide data for membrane and flexible flashings.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Locate where directed.
- C. Mock-up may remain as part of work.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Polyurethane Waterproofing:
 - 1. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/#sle.
 - 2. Gaco Western: www.gaco.com/#sle.
 - 3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 4. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 FLUID-APPLIED WATERPROOFING MATERIALS

- A. Polyurethane Waterproofing: Cold-applied two component polyurethane, complying with ASTM C836/C836M.
 - 1. Cured Thickness: 20 mils, .02 inch (____ mm), minimum.
 - 2. Suitable for installation over gypsum substrates.
 - 3. Tensile Strength: 400 psi (2.758 MPa), minimum, measured in accordance with ASTM D412.
 - 4. Ultimate Elongation: 168 percent, minimum, measured in accordance with ASTM D412.
 - 5. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240.
 - 6. Adhesion: 150 psi (1.03 MPa), minimum, measured in accordance with ASTM D4541.
 - 7. Brittleness Temperature: Based on minus 50 degrees F (minus 46 degrees C), measured in accordance with ASTM D746.
 - 8. Products:
 - a. Carlisle Coatings & Waterproofing, Inc; CCW 703 Liquiseal: www.carlisleccw.com/#sle.
 - b. Gaco Western; GacoFlex LM-60: www.gaco.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.03 ACCESSORIES

- A. Counterflashings: Galvanized steel type, 0.01 inch (0.25 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Install cant strips at inside corners.

3.03 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. At joints and cracks less than 1/2 inch (13 mm) in width including joints between horizontal and vertical surfaces, apply 12 inch (300 mm) wide strip of joint cover sheet.

- D. At joints from 1/2 inch to 1 inch (12.7 mm to 25.4 mm) in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch (31.8 mm to 44.5 mm), and extend sheet at least 6 inches (152 mm) on either side of expansion joint.
- E. Center joint cover sheet over joints, roll sheet into 1/8 inch (3.2 mm) thick coating of waterproofing material and apply second coat over sheet extending at least 6 inches (152 mm) beyond sheet edges.
- F. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches (150 mm) above horizontal surface for first ply and _____ inches (_____ mm) at subsequent plies laid in shingle fashion.
- G. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- H. Seal membrane and flashings to adjoining surfaces.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing.
- C. Provide daily on-site attendance of waterproofing and insulation manufacturer's representative during installation of this work.
- D. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.

3.05 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 2100 THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rigid board continuous wall insulation where shown on drawings or required.
- B. Batt insulation used for thermal and sound insulation in stud walls, above lay-in ceiling panels, and where shown on drawings or required.

1.02 RELATED WORK

- A. Section 07 2620 – Fluid Applied Air Barrier System
- B. Section 07 8100 - Sprayed Fireproofing
- C. Section 07 8400 - Firestopping and Fire Safing
- D. Section 09 5100 - Acoustical Lay-In Ceiling: Installation of acoustical insulation above lay-in ceiling panels as specified.
- E. Division 23 - Mechanical: Duct insulation

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature on each insulation type specified.
 - 2. Manufacturer's installation instructions for each insulation type specified.
- B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect's approval.
- C. Certifications:
 - 1. Manufacturer's certification of compatibility of rigid insulation with dampproofing mastic.
 - 2. Manufacturers affidavit that materials used in Project contain no asbestos.
- D. Requests for substitutions will be considered in accordance with provisions of Section 01 2516

1.04 COORDINATION

- A. Furnish acoustical insulation to acoustical lay-in ceiling contractor for laying insulation above lay-in ceiling panel system specified.

1.05 QUALITY ASSURANCE

- A. Pre-Installation Meeting: Convene minimum one week prior to commencing Work of this section. Review installation procedures and coordination required with Related Work and include the following:
 - 1. Participants: Authorized representatives of teh Contractor, Architect, Installer, and Manufacturer.
 - 2. Review wall assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
 - 3. Review continuous insulation wall panels installation methods and procedures related to application, including manufacturer's installation guidelines.
 - 4. Review firestopping requirements and weather resistive membrane requirements and placement locations.
 - 5. Review field quality control procedures.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS/PRODUCTS

- A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.
 - 1. Rigid Wall Insulation:
 - a. Extruded Polystyrene Foam Board:

- 1) Dupont; Thermax (ci)
 - 2) Hunter Xci Foil Class A Plus
 - 3) Atlas; EnergyShield PRO
2. Batt Thermal Insulation:
 - a. Walls: For use in partition thermal applications.
 - 1) CertainTeed Corp. (AcoustaTherm)
 - 2) Guardian Fiberglass, Inc.(Thermal & Sound Control Batts)
 - 3) Johns-Manville (Thermal-SHIELD Thermal Insulation)
 - 4) Knauf (QuietTherm Insulation)
 - 5) Owens-Corning (Thermal Batt Insulation)
 3. Batt Acoustical Insulation (Sound Attenuation):
 - a. Walls/Ceilings: For use in partition acoustical applications and above lay- in ceilings as specified and where shown on drawings.
 - 1) CertainTeed Corp. (CertaPro AcoustaTherm)
 - 2) Guardian Fiberglass, Inc. (Thermal & Sound Control Batts)
 - 3) Johns-Manville (Sound-SHIELD Sound Control Batts)
 - 4) Knauf (QuietTherm Insulation)
 - 5) Owens-Corning (Above Ceiling – Sonobatts; Walls – Sound Batt))
 - (a) Thermafiber Sound Attenuation Fire Blanket (SAFB) Insulation
 4. Safing Insulation: As specified in Section 07 8400, Fire Stopping and Fire Safing.

2.02 MATERIALS

- A. Rigid Wall Insulation: (In Exterior Walls)
 1. Polyisocyanurate Foam Board:
 - a. Specification: ASTM C518 or C1289
 - b. Thermal Resistance: R=6.5 per inch minimum.
 - c. Water Absorption (% by volume): 0.1 maximum
 - d. Water Vapor Permeance (perm): <0.04 per inch
 - e. Compressive Strength: 25 psi minimum
 - f. Thickness: 1 inch, unless shown otherwise
 - g. Size: 48 inch x 96 inch sheets.
 - h. Size: 16 inch x 96 inch sheets when used over masonry substrate
- B. Batt Insulation:
 1. Thermal Insulation:
 - a. Type: ASTM C665, Type 1, unfaced
 - b. Thickness/R-Values (minimum):
 - 1) 3-1/2 inches/R-13 where shown on drawings.
 - 2) 6 inches/R-19 where shown on drawings.
 - c. Surface Burning Characteristics:
 - 1) Flame Spread: 25 or less
 - 2) Smoke Developed: 50 or less
 2. Acoustical (Sound Attenuation) Insulation:
 - a. Type: ASTM C665, Type 1, unfaced
 - b. Surface Burning Characteristics:
 - 1) Flame Spread: 25 or less
 - 2) Smoke Developed: 50 or less
 - c. Thickness/R-Values (minimum):
 - 1) 3-1/2 inches/R-11 where shown on drawings.
 - 2) 6 inches/R-19 above lay-in ceiling specified and where shown on drawings.
- C. Safing Insulation: As specified in Section 07 84 00, Fire Stopping and Fire Safing.
- D. Miscellaneous Materials:

1. Mechanical Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered or mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
2. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Rigid Board Insulation:
 1. Install board insulation at exterior walls in accordance with manufacturer's printed instructions.
 2. Cut insulation to fit snugly around obstructions such as vents, pipe or conduit.
 3. Install board insulation to back-up wall surface secured by veneer wall ties and mastic.
 4. Install board insulation with joints tight to veneer wall ties and to provide full coverage.
- B. Batt Insulation (Thermal and Sound):
 1. Walls:
 - a. Insulation shall be friction fit between studs and provide full coverage where indicated on drawings.
 - b. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
 - c. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.
- C. Safing Insulation: As specified in Section 07 8400, Fire Stopping and Fire Safing.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, exterior penetrations, _____, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.
- C. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- G. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Set splash pads under downspouts.

END OF SECTION

SECTION 07 9200 JOINT SEALANTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exterior sealants and sealants for moving joints, except for joints in those systems listed under Related Work.
- B. Interior sealants and caulking.

1.02 RELATED WORK

- A. Section 04 20 00 - Unit Masonry: Masonry control and expansion joints.
- B. Division 7 - Roofing Sections: Sealants used in conjunction with roofing.
- C. Section 07 84 00 - Firestopping: Firestopping penetrations.
- D. Section 07 62 00 - Sheet Metal Flashing, Gutters, Downspouts and Trim: Sealants used in conjunction with sheet metal items.
- E. Section 08 80 00 - Glazing Systems: Glazing sealants.
- F. Section 09 21 16 - Gypsum Board assemblies: Acoustical sealants.
- G. Division 23 - Mechanical Sections.
- H. Section 32 13 13 - Concrete Paving: Site concrete paving expansion joint sealant.

1.03 REFERENCES

- A. ASTM International (ASTM)
 - 1. C717, Standard Terminology of Building seals and Sealants
 - 2. C793, Standard Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants
 - 3. C794, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - 4. C834, Standard Specification for Latex Sealants
 - 5. C920, Standard Specification for Elastomeric Joint Sealants
 - 6. C1193, Standard Guide for Use of Joint Sealants
- B. Sealant, Waterproofing and Restoration Institute (SWRI)
 - 1. The Professional's Guide

1.04 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Sample: On site sample for Architect's approval of colors.
- C. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced in building sealant installation whose work has resulted in sealant installations with a record of successful performance.
- B. Source Limitations: Unless specifically indicated, obtain each type of building sealant through one source from a single manufacturer.
- C. Pre-construction Field Adhesive Testing: Prior to installation of building sealants, field test their adhesion to joint substrates in accordance with manufacturer's instructions. Perform test in locations indicated by Architect. Perform test for each type of building sealant and each substrate as required by Architect. If required by Architect, arrange for tests to be performed with sealant manufacturer's representative present. Follow-up review by Architect and

manufacturer may be required to observe sealant performance over time and may result in re-application of sealant or replacement.

- D. Cleaning: Facade sealants that have collected dirt at the time of Substantial Completion shall be cleaned over the entire facade prior to acceptance by the Owner. 11 months after final completion of the building, if the sealant joints show dirt, they shall again be cleaned over the entire façade.

1.06 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of sealants when joint substrates are wet or when ambient temperature conditions are above limits permitted by sealant manufacturers or are below 40 degree F.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of sealants until contaminants which may interfere with adhesion are removed from substrates.

1.07 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.
- B. In addition, refer to information above concerning Field Adhesive Testing.

1.08 WARRANTY

- A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Leaking
 2. Cracking, splitting or releasing from substrate
 3. Deterioration or color change

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Specifications are based on the products or materials of the named manufacturer, otherwise selection may be made from any manufacturer listed below whose products meet or exceed the specifications. Other manufacturers must have a minimum of five (5) years' experience manufacturing the products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 1. Typical Sealants:
 - a. BASF
 - b. Bostik
 - c. Pecora, Inc.
 - d. Sika
 - e. Tremco Incorporated
 2. Silicone Sealants at Appliances:
 - a. Pecora, Inc.
 - b. General Electric Co.
 - c. Dow Corning

2.02 MATERIALS

- A. Caulking for Exposed Non-Working Interior Locations:
 1. Type: Acrylic Latex, conforming to ASTM C834; single component, paintable.
 2. Applications: Use for interior wall and ceiling joints, joints between door and window frames and wall surfaces, and other interior non-traffic-bearing joints for which no other type of sealant is indicated.
- B. Sealant for Working Joints and Exposed Vertical Exterior Locations:

1. Type: Polyurethane, conforming to ASTM C920, Type S or M, Grade NS, Class 35; single or multi-component, non-sagging.
2. Applications: Use for:
 - a. Control, expansion, and soft joint masonry. Refer to drawings and Section 04
 - b. Provide full sealant joints at building expansion joints.
 - c. Joints between concrete and other materials.
 - d. Joints between metal frames and other materials.
 - e. Other exterior non-traffic-bearing joints for which no other type of sealant is indicated.
- C. Sealant for Exposed Exterior Traffic-bearing Locations:
 1. As specified in section 32 13 13, Concrete Paving
- D. Rubber Sealant:
 1. Type: Butyl sealant, conforming to ASTM C920, Type NT, Grade NS, Class 12- 1/2; single component, solvent release, non-skimming, non-sagging.
 2. Movement Capability: Plus and minus 12-1/2 percent.
 3. Service Temperature range: -13 to 180 degree F.
- E. Sealant at Sanitary Locations:
 1. Type: Single component, silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 25, mildew resistant, non-yellowing.
 2. Application: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between kitchen and bathroom counter tops and wall surfaces, unless indicated otherwise. Use at all Kitchen appliances.
 3. Approved Product / Manufacturer: Sanitary SCS1700 Sealant manufactured by General Electric Company, Pecora Corp., Dow Corning, or Architect approved equal.
- F. Primers, Cleaners, Top Coats: Use only materials listed as suitable in resistance to staining, compatibility and durability before proceeding.
- G. Expanded Polyethylene Joint Filler: Provide flexible, compressible, closed-cell, polyethylene of not less than 10 psi compression deflection (25 percent); except provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants, surface water absorption of not more than 0.1 pounds per square foot, as manufactured by Sonneborn, or pre-approved equal.
- H. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type, which will not be deteriorated by sealant application temperature as indicated.
- I. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Temperatures: Do not install sealants when air temperature is under 40 degrees F. Sealants may be warmed to ease installation when recommended by the manufacturer.
- B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the groove. No materials shall be left "feathered" out or smeared on the abutting materials. If necessary, protect adjacent surfaces with tape. Completed joints shall have a uniform professional appearance. Use an anti-tack compound on sealant that does not set up fast enough to avoid dust collection.
- C. Sealant Back-Up: Provide back-up filler where groove depth is too great to fill with sealant. Review joint design with Architect.

- D. Compressive Filler: Seal vertical expansion joints with fillers. Provide compressible filler twice the width of the joint and with a depth of 1-1/2 times the compressed width. Lap ends 2 inch minimum.
- E. Seal ends together in such a manner to allow natural drainage. Install filler by compressing material and sliding into joint. Align filler on one face of the joint before it expands to the full joint width.

END OF SECTION

SECTION 07 9500 EXPANSION CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Floor expansion joint cover assemblies, wall and ceiling expansion joint cover assemblies, and fire barrier systems where indicated on drawings or required.

1.02 RELATED WORK

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 04 20 00 - Unit Masonry
- C. Section 05 50 00 – Metal Fabrications
- D. Section 07 72 00 - Roof Accessories: Roof expansion joints.
- E. Section 07 92 00 - Joint Sealants

1.03 REFERENCES

- A. ASTM International (ASTM)
 - 1. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 2. B221, Standard Specification for Aluminum-Alloy, Extruded Bars, Rods, Wire, Shapes, and Tubes
 - 3. D2000, Standard Classification System for Rubber Products in Automotive Applications
- B. Underwriters Laboratories, Inc. (UL)
 - 1. Fire Performance Characteristics

1.04 QUALITY ASSURANCE

- A. Materials and work shall conform to the latest edition of reference specifications specified herein and to all applicable codes and requirements of local authorities having jurisdiction.
- B. Where indicated, provide expansion joint cover assemblies to meet UL requirements.
 - 1. Fire Rating: Not less than the rating of adjacent construction.
- C. Standard floor covers should be designed to withstand a minimum point load of 500 pounds without damage or permanent deformation.
- D. Single-Source Responsibility: Obtain expansion joint cover assemblies from one source from a single manufacturer.

1.05 SUBMITTALS

- A. Product Data: Submit copies of manufacturer's latest published literature for materials specified herein for approval, and obtain approval before materials are fabricated and
 - B. delivered to the site.
- C. Certificates: Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint assemblies with requirements indicated.
- D. Shop Drawings: Submit shop drawings for work specified herein for approval and obtain approval prior to fabrication and shipment of materials to the job site.
 - 1. Shop Drawings showing full extent of expansion joint cover assemblies; include large scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joinery with other types, special end conditions, anchorages, fasteners, and relationship to adjoining work and finishes. Include description of materials and finishes and installation instructions.
- E. Samples: Samples of materials specified herein and shall be submitted for approval, and approval obtained before materials are delivered to the site. Samples shall include the following:

1. Samples for each type of metal finish indicated on metal of same thickness and alloy to be used in work.
2. Samples of each type of flexible seal to be used in work with color samples as above.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Exercise proper care in the handling of all work so as not to injure the finished surface, and take proper precautions to protect the work from damage after it is in place.
- B. Deliver materials to the job site ready for use, and fabricated in as large sections and assemblies as practical.
- C. Store materials under cover in a dry and clean location off the ground. Remove materials which are damaged or otherwise not suitable for installation from the job site and replace with acceptable materials at no additional cost.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 1. Architectural Art Mfg., Inc.
 2. Balco Metalines
 3. Construction Specialties, Inc. (C/S Group).
 4. D & B X-pansion Joints, Inc.
 5. InPro Corporation
 6. MM Systems Corporation
- B. Specifications are based on products of MM Systems Corporation.

2.02 MATERIALS

- A. Aluminum: ASTM B221, alloy, 6063-T5 for extrusions; ASTM B209, alloy 6061-T6, for sheet and plate.
- B. Protective Coating: Zinc chromate primer or chromate conversion coating for protection of aluminum surfaces in contact with cementitious materials.
- C. Extruded Preformed Seals: Single or multilayered rubber extrusions as classified under ASTM D2000, designed with or without continuous, longitudinal, internal baffles and formed to fit compatible frames, color as selected by Architect from manufacturer's standard colors.
- D. Fire Barriers: Designed for indicated or required dynamic structural movement without material degradation or fatigue.
- E. Accessories: Manufacturer's standard anchors, fasteners, set scores, spacers, flexible vapor seals and filler materials, drain tubes, adhesive and other accessories compatible with material in contact, as indicated or required for complete installations.

2.03 FABRICATION

- A. Provide expansion joint assemblies of design, basic profile, materials, and operation indicated. Select units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces, and structural movement. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes direction or abuts other materials. Include closure materials and transition pieces, tee-joints, corner, curbs, cross-connections, and other accessories as required to provide continuous joint cover assemblies.
- B. Interior Joint Covers (As shown or required)
 1. Floor to Floor:
 - a. Model LASB-NBR at resilient flooring or tile.
 - b. Model LASB-NBR at carpet to carpet.

- c. Model LASB-NBR at resilient flooring to carpet.
2. Floor to Wall:
 - a. Model HSLE at carpet on floor.
 - b. Model HSLE at resilient flooring or tile on floor.
3. Wall to Wall: Model FX-K
4. Corner Wall: Model FX-L
5. Wall to Ceiling: Model DX
6. Ceiling to Ceiling: Model DX
7. Unexposed Areas: 0.030 inch thick Formed Galvanized Steel Cover
 - 1) Fire Barriers: Provide "Pyro-Flex" Model at Second & Third Floor slab joints in fire rating as scheduled or required to complete UL assembly.
 - 2) Aluminum Finishes: Clear Anodized Finish - AA-C22A41; medium matte etched finish with 0.07 mil thick minimum thick anodic coating.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Make a thorough examination of all surfaces receiving the Work of this Section, and before starting the installation, notify Architect, in writing, of any defect which would affect the satisfactory completion of the Work of this Section.

3.02 PREPARATION

- A. Examine the Contract Drawings and Specifications in order to insure the completeness of the work required under this Section.
- C. Verify all measurements and dimensions at the job site and cooperate in the coordination and scheduling of the Work of this Section with the work of related trades, with particular attention given to the installation of items embedded in concrete and masonry so as not to delay job progress.
- D. Provide all templates as required to related trade for location of all support and anchorage items.

3.03 INSTALLATION

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for all phases of work, including preparation of substrate, applying materials, and protection of installed units.
- B. Provide anchorage devices and fasteners where necessary for securing expansion joint cover assemblies to in-place construction, including threaded fasteners with drilled-in fasteners for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
- C. Perform all cutting, drilling and fitting required for installation of expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels.
- D. Set floor covers at elevations to be flush with adjacent finished floor materials. If necessary, shim to level, but ensure base frames have continual support to prevent rocking and vertical deflection.
- E. Locate wall, ceiling, roof, and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with all required accessories.
- F. Locate anchors at intervals recommended by manufacturer, but not less than three (3) inches from each end and not more than 24 inches on center.
- G. Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames.

H. Installation of Fire Barrier:

1. Install fire barrier in accordance with Federal, State, and local building codes using manufacturer's recommended procedures.
2. Install transition and end joints to provide continuous fire resistance and in accordance with manufacturer's instructions.

3.04 CLEANING

- A. Do not remove strippable protective material until finish work in adjacent areas is complete.
- B. When protective material is removed, clean exposed metal surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide items shown on the drawings and specified, including, but not limited to the following:
 - 1. Standard and fire rated steel doors
 - 2. Steel frames for doors, sidelites, transoms, and windows.
 - 3. Louvers and vision lites in steel doors, if shown or required.

1.02 RELATED WORK

- A. Section 05 40 00 – Cold Formed Metal Framing
- B. Section 05 5000 – Metal Fabrications
- C. Section 08 1423.16 - Plastic Laminate Faced Wood Doors
- D. Section 08 7100 - Finish Hardware (Allowance)
- E. Section 08 8000 - Glazed Systems: Glazing in doors, sidelites, transoms, and windows.
- F. Section 09 9100 - Painting and Staining

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. IG, Installation Guide for Doors and Hardware
 - 2. 1, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames.
 - 3. 8, Recommended Specifications for Standard Steel Doors and Frames. (Formerly SDI-100)
 - 4. 11, Recommended Erection Instructions for Steel Frames (Formerly SDI- 105).
- B. ASTM International (ASTM)
 - 1. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. A924, Standard Specification for General Requirements for Steel Sheet, Metallic- Coated by the Hot-Dip Process
 - 3. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 4. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 5. C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus
 - 6. E283 – Standard Test Method for Determining the rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 7. E413 - Standard Classification for Rating Sound Insulation
 - 8. E2074, Standard Test Method for Fire Tests of Door Assemblies (Formerly A152)
- C. Federal Specification (Fed Spec)
 - 1. Fed Spec C578 Bead Fusion Test
- D. Hollow Metal Manufacturers Association (HMMA)
 - 1. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames.
 - 2. HMMA 810 - Hollow Metal Doors.
 - 3. HMMA 830 - Hardware Preparation and Locations for Hollow Metal Doors and Frames.
 - 4. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.
 - 5. HMMA 850 - Fire Rated Hollow Metal Doors & Frames.
 - 6. HMMA 890 - Technical Summary of Hollow Metal by HMMA

- E. National Fire Protection Association (NFPA)
 - 1. 80, Fire Doors and Fire Windows
 - 2. 252, Fire Tests of Door Assemblies
- F. Steel Door Institute – Current Standards
 - 1. Technical Data Series
- G. Underwriters Laboratories Inc. (UL)
 - 1. Building Materials Directory
 - 2. Listing and Labeling
 - 3. 10B and 10C, Fire Tests of Door Assemblies
 - 4. 1784, Air Leakage Tests of Door Assemblies
- H. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
 - 1. Listing and Labeling

1.04 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the Contract Drawings. If any door is not by the steel door manufacturer only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.).
 - 2. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
 - 1. 12 inch x 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
 - 2. 12 inch x 12 inch sample of each type of door louver specified or required, showing louver construction.
 - 3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.
- D. Certificates:
 - 1. Manufacturer's certification that oversized openings are in compliance with specifications.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: If other than a manufacturer listed under Paragraph 2.1 is proposed for use on the Project, it shall be a company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of five (5) years experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. ANSI/SDI-A250.13 (2003) Testing and Rating of Severe Windstorm Resistant Components for Swing Door Assemblies.
- E. ASTM E 330-97, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- F. Comply with 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.

1.06 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies:
 - 1. Fire-Rated Door, Panel, Frame, and Fire Window Construction: Shall conform to ASTM E2074, NFPA 252, or UL 10B, as applicable, and acceptable to the code authorities having jurisdiction.
 - 2. Fire-Rated Door Construction:
 - a. Not notwithstanding any other requirements of this Specification, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E). Doors with "B" Label shall be 1-1/2 hour.
 - 3. Fire-Rated Openings: Conform to NFPA 80 for fire-rated class shown or required by code authorities having jurisdiction.
 - a. Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified under Paragraph C, 01, above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code authorities having jurisdiction.
 - b. Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
 - c. Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.
 - d. Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
 - e. Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
 - f. Caution shall be taken to ensure that labels are not removed, damaged or painted over.
 - g. Glass panes shall not exceed sizes allowed whether indicated or not on the drawings.
- B. Wind Loads: Provide hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding windload design pressures which are calculated for this project by a registered Architect or Engineer and is part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction and the International Building Code Design Loads per section 1609.

1.07 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 3113 – Project Coordination.

1.08 COORDINATION

- A. Coordinate the Work of this Section with work in which hollow metal work is installed.
- B. Coordinate hardware installation with opening construction. Finish hardware is specified in Section 08 7100.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 8000.
- D. Coordinate doors and frames with painting specified in Section 09 9100.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
 - 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
 - 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage.

1. Store under cover in a clean, dry place, protected from weather and abuse.
2. Store in a manner that will prevent rust or damage.
3. Store doors in a vertical position, spaced with blocking to permit air circulation.
4. Do not use non-vented plastic or canvas shelters.
5. Should containers or wrappers become wet, remove immediately.

1.10 WARRANTY

- A. Warrant the work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Use of incorrect materials in opening
 2. Incorrect labeled components installed within opening.
 3. Noisy, rough or difficult operation
 4. Failure to meet specified quality assurance requirements.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must comply with Paragraph 1.5, A, Manufacturer Qualifications, must manufacture equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
 1. CECO Door Products, Brentwood, TN; (615) 661-5030
 2. Deansteel Mfg. Co., San Antonio, TX; (210) 226-8271
 3. Door Pro Systems, Inc., Houston, TX; (713) 462-0860
 4. Steelcraft Mfg. Co., Cincinnati, OH; (513) 745-6400

2.02 MATERIALS, GENERAL

- A. Steel requirements, all frames to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel per ASTM-A1008 general requirements. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A1011.
- B. Exterior frames and interior frames where shown on drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvannealed to 'A-60' minimum coating weight standard per ASTM-A653 and A924, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

2.03 FRAME FABRICATION

- A. Minimum Gauges:
 1. Interior Openings:
 - a. Less than 4 feet-0 inches in Width: 16 gauge
 - b. 4 feet-0 inches in Width and greater: 14 gauge
 2. Exterior Openings: 14 gauge
- B. Design and Construction:
 1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least four (4) inch wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shallmatch wall thickness where practical, i.e., 4-3/4 inch at 4 inch CMU, 6-3/4 inch at 6 inch CMU, and 8-3/4 inch at 8 inch CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch head member.
 2. Frames shall be strong and rigid, neat in appearance, square, true and free of defects, warp and buckle. Molded members shall be clean cut, straight and of uniform profile throughout their length.

3. Jamb depths, trim, profile and backbends shall be as shown on approved shop drawings.
4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.
6. Frames for multiple openings shall have mullion and rail members which are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to Owner's Best system.
7. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8 Finish Hardware.
9. 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.
10. Provide A60 Galvannealed coating at frames in restrooms and locker rooms with showers/Jacuzzi, clean areas such as kitchen rooms.
11. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic licks as noted in door hardware sets in Division 8 Finish Hardware.
 - a. Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations for all exterior locations regardless of electrical hardware specified in Division 8 Finish Hardware.
 - b. Provide electrical knock out boxes with 3/4-inch knockouts.
 - c. Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
 - d. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 8 Finish Hardware.
 - e. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
 - f. Provide field installed conduit per Division 28 section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Finish Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
12. Hardware Reinforcements:
 - a. Frames shall be mortised, reinforced, drilled and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4 inch x 10 inch minimum size): 7 gauge
 - 2) Strike reinforcements: 12 gauge
 - 3) Flush bolt reinforcements: 12 gauge
 - 4) Closer reinforcements: 12 gauge
 - 5) Reinforcements for surface-mounted hardware, hold-open arms, surface panic devices: 12 gauge
13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.

14. Jamb Anchors:
 - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-Strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
 - 1) Frames up to 7 feet-6 inch height - Three (3) anchors
 - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Four (4) anchors
 - 3) Frames over 8 feet-0 inch height - One (1) anchor for each 2 feet or fraction thereof in height.
 - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to 7 feet-6 inch height - Four (4) anchors
 - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Five (5) anchors
 - 3) Frames over 8 feet-0 inch height - Four (4) anchors plus one (1) additional for each 2 feet or fraction thereof over 8 feet-0 inches.
 - c. Frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
 15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. Eight (8) inch CMU walls with face brick shall have dual offset jamb anchors.
 16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
 17. Loose Glazing Stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
 18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.
- C. Frame Color: Field painted under Section 09 91 00 to match face of door.

2.04 DOOR FABRICATION

- A. Minimum Gauges:
 1. Interior Doors: 0.047 inch or 18 gauge (16 gauge for high frequency doors)
 2. Exterior Doors: 0.059 inch or 16 gauge (14 gauge for windstorm rated doors)
- B. Design and Construction:
 1. Types: Doors shall be custom fabricated, of types and sizes shown on approved shop drawings, and shall be seamless face construction with no visible seams or joints on vertical edges with fully welded seams free from blemishes and defects. Thickness: Shall be 1-3/4 inch, unless specifically noted or shown otherwise.
 2. Exterior Doors: Provide doors with 22 gage steel z-channels placed at 6 inches apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
 3. Fabrication:
 - a. Doors shall be strong, rigid and neat in appearance, free from warpage and buckle.
 - b. Corner bends shall be true and straight and of minimum radius for gage of metal used.
 - c. Provide 22 gauge steel stiffeners spaced maximum six (6) inches on center and extending full height of door.
 - d. Fill interior with noncombustible fiberglass insulation. Use mineral board filler as required for labeled doors.
 - e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled and dressed smooth to provide a smooth flush surface.

- f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
 - g. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8 Finish Hardware.
 - h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Finish Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
 - i. Doors within in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
 - j. Edge profile shall be provided on both vertical edges of door as follows:
 - 1) Single-Acting Swing Doors: Beveled 1/8 inch in 2 inches.
 - k. Hardware Reinforcements:
 - 1) Doors shall be mortised, reinforced, drilled and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
 - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
 - (a) Hinge & pivot reinforcements: 7 gauge
 - (b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge
 - 4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
 - 5. Louvers: Shall be inverted "V" blade, sightproof type, unless noted otherwise.
 - 6. Edge Clearances:
 - a. Between Door and Frame at Head and Jambs: 1/8 inch
 - b. At DoorSills with No Threshold: 5/8 inch to 3/4 inch above finished floor
 - c. At DoorSills with Threshold: As required to suit threshold
 - d. Between Meeting Edges of Double Doors: 1/8 inch
- C. Finish:
- 1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
 - a. Clean surfaces free of mill scale, rust, oil, grease, dirt and other foreign matter.
 - b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.
 - 2. Field painted under Section 09 91 00.

2.05 LABELED DOORS AND FRAMES

- A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.
- B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware or other reason; the Architect shall be so advised before fabrication work on that item is started.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
 - 1. Anchorage and Connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
 - 2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
 - 3. Frame Spreader Bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
 - 4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
 - 1. Install hardware in accordance with hardware manufacturer's templates and instructions.
 - 2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
 - 3. Adjust operable parts for correct function.
 - 4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled doors.

3.02 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION

SECTION 08 1423
PLASTIC LAMINATE FACED WOOD DOORS

PART 1 - GENERAL

1.01 RELATED WORK

- A. Section 06 2000 - Finish Carpentry: Installation of doors and finish hardware.
- B. Section 08 1113 - Hollow Metal Doors and Frames: Door frames.
- C. Section 08 7100 - Finish Hardware
- D. Section 08 8000 - Glazed Systems: Vision glazing types for factory glazing
- E. Section 09 9100 - Painting and Staining: Painting of glass stops to match door frames.

1.02 REFERENCES

- A. Architectural Woodwork Institute (AWI) – Veneer Standards.
- B. National Fire Protection Association (NFPA)
 - 1. 80, Fire Doors and Fire Windows
 - 2. 252, Fire Tests of Door Assemblies
- C. Underwriters Laboratories (UL)
 - 1. Building Materials Directory
 - 2. Listing and Labeling
 - 3. 10 (c), Fire Tests of Door Assemblies - Positive Pressure
- D. Wood Door and Window Manufacturers Association (WDMA) I.S. 1A – Flush Wood Door Performance Standards
- E. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
 - 1. Certification Listings for Fire Doors

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Show or schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, fire rating, and other pertinent data for each door required.
 - 2. Include schedule of hardware preparation required for each door.
 - 3. Indicate requirements for veneer matching.
- C. Samples: Plastic laminate in colors and patterns for Architect's selection.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with AWI Quality Standards, Custom Grade A.
- B. Comply with WDMA I.S. 1A, 2004 Edition "Industry Standard for Architectural Wood Flush Doors and exceed Extra heavy Duty performance standards.
- C. Fire Rated Door Construction:
 - 1. Conform to ASTM E2074, NFPA 252, or UL 10 (c) as applicable and as required by code authorities having jurisdiction.
 - 2. Fire doors shall bear labels, permanently attached to the hinge stile or to top rail that:
 - a. Allows label to be visible when door is open.
 - b. Are approved by and shows testing laboratory approval for classification specified, scheduled or required. The testing laboratory shall be UL or WHI.
- D. Fire Rated Door Installation:
 - 1. Conform to NFPA 80 and as required by code authorities having jurisdiction.

1.05 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver to site, store, protect, and handle doors in accordance with AWI Quality Standards and manufacturer's instructions. Accept doors on site in manufacturer's standard packaging. HVAC systems shall be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25 percent nor greater than 55 percent.
- B. Storage:
1. Store doors in a clean and dry location protected from weather and abuse.
 2. Stabilize moisture content prior to installation.
- C. Mark each door on the top or in the top hinge with opening numbers corresponding to approved shop drawings.

1.07 WARRANTY

- A. Provide for lifetime replacing, including cost of rehanging and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, but not limited to the following:
1. Warp in excess of 1/4 inch as defined by AWI.
 2. Warp or twist to a degree that door will not operate properly.
 3. Delamination of face.
 4. Telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Manufacturers listed or named in the specifications who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
1. Doors:
 - a. Haley Bros. Inc.
 - b. Ideal Architectural Door & Plywood
 - c. Marshfield Doors Systems, Inc.
 - d. Oshkosh Architectural Door Company
 - e. VT Industries
 2. Plastic Laminate:
 - a. Formica Corp.
 - b. Nevamar, International Paper, Decorative Products Division
 - c. Pionite Decorative Surfaces
 - d. Wilsonart International

2.02 MATERIALS

- A. Flush Interior Non-Rated Wood Doors – Plastic Laminate:
1. General: 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL), Bonded Particle Core, stile and rails abrasively planed as an assembly prior to laminating, factory machine and fit.
 2. Thickness: 1-3/4 inch.
 3. Core: 32 lbs per cubic foot particleboard, 1LD2 in accordance with ANSI A208.1
 - a. Furnish Structural Lumber Core:
 - 1) At doors with more than 40 percent of door core removed due to light or vent cutouts.
 - 2) At doors with exit devices
 4. Stile: LSL, 1-3/8 inch, bonded to core

5. Rail: LSL, bonded to core, 1-1/8 inch minimum, 5 inch head rail for closer reinforcement.
- B. Flush Interior Fire Rated Wood Doors:
 1. Meet applicable requirements of Paragraph A above.
 2. Doors scheduled to be fire-rated shall receive the appropriate label. Schedule and conform to labeling requirements of code authorities having jurisdiction over this work.
 3. Core: 20 minute fire-rated, 1LD2 particleboard, positive pressure Category A. Comply with commercial standard CS 236 and AWI, furnish Structural Lumber Core at doors with more than 40 percent of door core removed due to light or vent cutouts, and at doors with exit devices.
- C. Mineral Core:
 1. Meet applicable requirements of Paragraph A above.
 2. Doors scheduled to be fire-rated shall receive the appropriate label. Schedule and conform to labeling requirements of code authorities having jurisdiction over this work
 3. Core: asbestos-free, incombustible mineral sections - 45, 60, or 90 minute fire- rated, positive pressure Category A.
 4. Blocking:
 - a. 7-inch top-rail blocking, in doors indicated to have closers.
 - b. 5-inch bottom-rail blocking, in doors indicating armor plates.
 - c. 5-inch mid-rail and corner blocking, in doors indicated to have exit devices.
 5. Stiles and Rails: Manufacturers thickness to achieve rating.
 6. Fire rating: as scheduled on drawings.
- D. Accessories:
 1. Glazing: Factory glaze with glass as indicated. Verify compatibility of glazing system with positive pressure requirements where applicable.
 2. Glass Stops: Glass stops, if any, shall be metal type painted to match door frame under Section 09 91 00. Stops prepared for countersink style tamper proof screws. Size for 6 inch by 36 inch vision glass, unless noted otherwise. Color will be approved by Architect.
 3. Adhesive: Type 1, hot pressed
 4. Plastic Laminate: 0.050 inch thick, as selected by Architect.
 5. Seal top, bottom and cut surface of openings at factory with two (2) coats of varnish.
 6. Vertical door edges shall be factory painted to match door face. Factory shall supply matching paint and edges shall be touched-up in field.
- E. Fabrication:
 1. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
 2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 3. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
 4. Doors with mortised hinges to be furnished pre-drill pilot holes for hinge screws.
 5. Electrical Wiring: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 8 "Finish Hardware".

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Doors and hardware installed under Section 06 20 00, Finish Carpentry and Millwork. Follow manufacturer's printed instructions. Coordinate work with door opening construction, and door and frame hardware installation.

- B. Clearances:
 - 1. Head and Jambs, meeting edges: 1/8 inch maximum.
 - 2. Sill: 1/2 inch typically, except provide 1/4 inch clearance from top surface of carpeting.
- C. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel. Reject doors with defects that are not repairable.
- D. Coordinate hardware installation for proper door operation. Adjust locks and latches to engage snugly without forcing. Align hardware to function without squeaking, binding, or racking. Mortise as required for automatic door bottoms.
- E. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of doors have been sealed prior to installation, as required for warranty.
- F. Interior Fire Rated Wood Doors installed where scheduled.
 - 1. Conform to NFPA 80, UL, and requirements of code authorities having jurisdiction.
 - 2. Do not trim positive pressure rated doors.
 - 3. Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80

3.02 CLEANING AND REPAIRING

- A. Clean doors in accordance with manufacturer's instructions.
- B. Repair or replace damaged doors at no expense to Owner.
- C. Do not remove or paint over labels on labeled doors.

END OF SECTION

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of glass.
- C. Door hardware.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- B. Section 08 8000: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 1. Design Wind Loads: Comply with requirements of ASCE 7.
 2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at a reference differential pressure across assembly of 1.57 psf (75 Pa) as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft (140 Pa).
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.

- G. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

1.05 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.07 MOCK-UPS

- A. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 PROJECT CONDITIONS

- A. Coordinate the work with installation of air barrier and vapor retarder components or materials.

1.10 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.11 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum-Framed Storefronts Manufacturers:
 1. Kawneer North America; _____: www.kawneer.com/#sle.
 2. Oldcastle BuildingEnvelope; _____: www.oldcastlebe.com/#sle.
 3. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Glazing Position: Centered (front to back).
 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).for exterior walls, 1-3/4" by 4-1/2" for interior stud walls.
 3. Finish: Superior performing organic coatings.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.

- b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - 4. Finish Color: As selected by Architect from manufacturer's standard line.
 - 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 - 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 - 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 - 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements
- 1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 - 2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.
 - 3. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 - 4. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
 - 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.
 - 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: See Section 08 8001.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Glass: As specified in Section 08 8000.
- D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- E. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- C. Color: As selected by Architect from manufacturer's standard range.

2.06 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware .
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.05 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 8000 GLAZED SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exterior and interior glass
- B. Glazing Sealant
- C. Aluminum framing systems, including storefront systems.
- D. Aluminum and glass entry doors.
- E. Glazing of hollow metal doors.
- F. Glazing of plastic laminate faced wood doors.

1.02 RELATED WORK

- A. Section 08 1113 - Hollow Metal Doors and Frames
- B. Section 08 1113.19 - Plastic Laminate Faced Wood Doors
- C. Section 08 7100 - Finish Hardware
- D. Section 07 9200 – Building Sealants – sealing adjacent construction materials

1.03 REFERENCES

- A. American Architectural Manufacturers Association
 - 1. AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site
 - 2. AAMA/NWWDA 101/I.S.2, Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors2.
 - 3. AAMA 502, Voluntary Specification for Field Testing of Windows and Sliding Glass Doors
 - 4. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum
 - 5. AAMA 2604, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
- B. American National Standards Institute (ANSI)
 - 1. , Safety Performance Specification
 - 2. , Safety Glass Code
- C. ASTM International (ASTM)
 - 1. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - 2. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 3. B210, Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
 - 4. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - 5. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
 - 6. C509, Standard Specification for Cellular Elastomeric Preformed Gasket and Sealing Material
 - 7. C1036, Standard Specification for Flat Glass
 - 8. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
 - 9. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - 10. E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
 - 11. E547, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential
- D. American Welding Society (AWS)

- E. Federal Specification (FS)
 - 1. DD-G-001403 B
 - 2. T-G-410, Sash putty
 - 3. TT-C-494, Bituminous Paint
 - 4. TT-S-00230, Sealing Compound: Synthetic Rubber Base and TT-S-00203C
 - 5. TT-S-001657, Sealing Compound: Butyl Rubber Base
 - 6. SS-C-153, Mastic Bulk Compound
- F. Flat Glass Marketing Association (FGMA)
 - 1. Glazing Sealing Systems Manual
 - 2. Glazing Manual

1.04 SUBMITTALS

- A. Shop Drawings: Complete shop drawings by manufacturer indicating elevations, sections, substrates, fasteners, finishes, hardware and installation details.
- B. Manufacturer's specifications and other data needed to prove compliance with specified requirements, and manufacturer's installation instructions.
- C. Engineer's calculations of performance requirements.
- D. Product data: manufacturer's specifications and test reports from an AAMA-accredited laboratory.
- E. Samples: Showing color
 - 1. Samples of each type of glass (12 inches x 12 inches minimum)
 - 2. In place sample of sealant at frame perimeter for Architect's approval. Architect will select colors from manufacturer's full available colors.
 - 3. Samples of framing finish and fastener types for Architect's approval. Architect will select finishes and colors from those available from manufacturer.
- F. Certification of Installation:
 - 1. Provide written certification stating that materials provided meet the specified requirements.
 - 2. Include the following specific information indicating their compliance with referenced standards.
 - a. Thermal movement
 - b. Structural properties
 - c. Water penetration
 - d. Air leakage
 - e. Finishes on aluminum surfaces

1.05 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.
- B. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with pertinent recommendations contained in the above referenced Flat Glass Marketing Association publications.
- C. Furnish a valid AAMA "Notice of Product Certification" indicating that the windows for the project conform to AAMA/NWWDA 101/I.S.2-97.

1.06 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle and protect windows and accessories in accordance with AAMA CW-10-97 until project completion

1.08 WARRANTY

- A. Warrant the work specified herein for (2) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 1. Faulty, improper or inadequate attachment or installation.
 2. Chipped edges, broken, or scratched glass.
 3. Defective finish of molding
 4. Distortion or waves

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 1. Glass:
 - a. AGC Flat Glass North America , Kingsport Tenn. (423) 229-7200
 - b. Guardian Industries Corp., Corsicana, TX; (800) 527-2511
 - c. Oldcastle Glass, Houston, TX; (866) 653-2278
 - d. Pilkington, Toledo, OH; (419) 247-4721
 - e. PPG Industries, Inc., Pittsburgh, PA; (412) 434-2858
 - f. Viracon, Owatonna, MN; (800) 533-2080
 2. Fire Rated Glass:
 - a. Oldcastle Glass "Pyroguard" Houston, Houston, TX; (866) 653-2278
 - b. Safti "Superlite C/SP", San Francisco, CA (888) 653-3333
 - c. Technical Glass Products "Firelite NT", Kirkland, WA (800) 451-9857
 - d. Vetrotech Saint-Gobain "Keralite FR-F", Auburn, WA (888) 803-9533
 3. Aluminum Framing System, and Doors:
 - a. ARCH Aluminum & Glass Co., Inc., "Amarlite" Architectural Products,
 - b. Tamarac, FL; (800) 432-8132
 - c. Columbia Commercial Building Products, Rockwall, TX; (800) 668-1645
 - d. EFCO Corp., Monett, MO; (800) 221-4169
 - e. Co., Inc., Jonesboro, GA; (770) 478-8841 (Basis of Specification)
 - f. Oldcastle Building Envelope, Houston, TX; (866) 653-2278
 - g. Tajima Corp USA, Los Angeles, CA; (818) 547-4595
 - h. Wausau Windows and Wall Systems, Wausau, WI; (877) 678-2983
 - i. YKK AP America, Inc., Grand Prairie, TX; (972) 206-2554
 4. Aluminum Window Manufacturers:
 - a. EFCO Corp., Monett, MO; (800) 221-4169
 - b. Kawneer Co., Inc., Jonesboro, GA; (770) 478-8841
 - c. Oldcastle Building Envelope, Houston, TX; (866) 653-2278
 - d. Any of the above manufacturers accepted for Aluminum Storefronts who produce aluminum windows as specified.

2.02 PERFORMANCE SPECIFICATIONS

- A. Requirements apply simultaneously through the most adverse conditions of each exterior application.
 1. Windloads: Design system to withstand positive and negative windloads normal to the plane of the wall in excess of 30 psf.
 2. Thermal Movement: Provide for noiseless expansion and contraction of all materials and assemblies due to temperature changes in a range between 10 degrees F and 180 degrees F without detriment to appearance or performance.

3. Water Infiltration: Drain water entering at joints and condensation occurring within the wall construction to the exterior face of the wall. Allow no uncontrolled water other than condensation on the interior face of the wall.
 4. Air Infiltration: Limit air leakage to maximum 0.06 cfm per square foot of wall projected area. (Storefront at 8 lb./sq.ft.)
- B. Aluminum Window Requirements Conformance to specifications in AAMA/NWWDA 101/I.S.2 when tests are performed on the prescribed 8'0" x 5'0" minimum test size with the following test results:
1. Air Infiltration: maximum .07 cfm/square foot when tested per ASTM E 283 at a static air pressure difference of 1.57 psf.
 2. Water Penetration: no uncontrolled water leakage when tested per ASTM E 547 and ASTM E 331 at a static air pressure difference of 10 psf
 3. Uniform Structural: window to be operable, and maximum .4% permanent deformation per member when tested per ASTM E 330 at a static air pressure difference of 67.5 psf.

2.03 MATERIALS

- A. Aluminum:
1. Aluminum Alloys: Comply with the standards and designations of the Aluminum Association and the following ASTM Standards:
 - a. Sheet and Plate: ASTM B209
 - b. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221.
 - c. Bars, Rods, and Wire: ASTM B211
 - d. Standard Structural Shapes: ASTM B308
 - e. Drawn Seamless Tube: ASTM B210
 - f. Extruded Structural Pipe and Tubes: ASTM B429
 - g. Welding Rods and Bare Electrodes: AWS Code
 2. Aluminum Finish: Clear Anodized.
 - a. Quality standard: conforming to AAMA 2604 for applied finishes or AAMA 661 for anodized finishes.
 - b. Pretreatment: five-stage; zinc chromate conversion coating.
 - c. Application: electrostatic spray and oven bake by approved applicator.
 - d. Coating quantity: minimum one primer coat and one color coat.
 - e. Dry film thickness: minimum 1.2 mils on exposed surfaces, except inside corners and channels.
 3. Color: chosen from manufacturer's standards
- B. Steel:
1. Carbon Steel: Refer to the Structural Steel Section. Provide structural reinforcement as required.
 2. Stainless Steel Fasteners: ASTM A167, type 302/304 No. 4 satin finish where exposed.
 3. Metals used for shims shall be galvanized steel (ASTM A36 or ASTM A283) where noted as steel and stainless steel (300 Series) where noted as stainless steel. Do not use aluminum or plastic shims unless approved by the Architect.
 4. Exposed Cladding, Trim and Panels: Provide cladding elements with formed edge flanges and backside stiffener members as required to maintain such flatness that when measured at room temperature the maximum slope of the surface at any point, measured from the nominal plane of the surface in its final installed position shall not exceed 1.25 degrees.
 5. Metal Protection: Materials used as permanent or temporary protection for metals shall conform with the following standards:
 - a. Bituminous Paint: FS TT-C-494 or MIL-P-6883A.
 - b. Mastic Bulk Compound: FS SS-C-153, Type I or Type II.
 - c. Preformed Mastic Tape: NAAMM Specifications for Non-Shrinking, Non-
 - d. Resilient Performed Sealing Compound
 - e. Zinc Rich Paint: MIL-P-38 336.

C. Glazing Materials at Hollow Metal Frames:

1. General: Use glazing compounds and preformed glazing sealants approved for the application and, except as otherwise specified, conforming to Glazing Materials portion of FGMA Glazing Manual.
2. Sealant:
 - a. One (1) part acrylic polymer sealant conforming to FS TT-S-00230 or silicone, FS TT-S-0023-C. Use for glazing of all fixed glass. Include primer as recommended by manufacturer.
 - b. Color: To match frame.
 - c. All sealants shall be compatible with adjacent material per manufacturer's instruction.
3. Setting Blocks: Hard rubber or clean grain softwood.
4. Foamed polyethylene or polystyrene rodstock, sizes as required by joint condition, and compatible with sealant.
5. Glazing Tape: DAP #1202 or as approved.
6. Glazing Gaskets: Extruded neoprene, free of porosity, surface defects, dimensional irregularities and conforming to physical properties of ASTM C509.
7. Use of metal sash putty will not be permitted, but compound conforming to FS T-G-410 will be permitted. The use of nonskinning compounds, nonresilient type preformed sealers, and preformed impregnated type gasket will not be permitted.

D. Glazing Materials at Aluminum Framing:

1. Glazing Gaskets: Extruded neoprene (Color: Black) sized to fit the frame.
2. Sealant: Comply with Federal Spec. TT-S-00230

E. Concealed Reinforcement Materials:

1. Steel:
 - a. Carbon Steel: Refer to the structural steel section. Provide structural reinforcement as required.
 - b. Metal Protection: Materials used as permanent or temporary protection for metals shall conform with the following standards:
 - 1) Bituminous Paint: FS TT-C-494 or MIL-P-6883A.
 - 2) Mastic Bulk Compound: FS SS-C-153, Type I or Type II.
 - 3) NAAMM Specifications for Non-Shrinking, Non-Resilient Performed Sealing Compound
 - 4) Zinc Rich Paint: MIL-P-38 336.

F. Glass:

1. General:
 - a. Glass shall meet the requirements of ASTM C1036.
 - b. Float Glass: Care shall be taken to minimize the tong marks and, unless indicated otherwise on the drawings, the tong marks shall occur at the bottom of the glass (after installation).
 - c. All glass shall be heat strengthened unless noted otherwise.
 - d. Color of tinted glass shall be as selected by Architect.
 - e. Safety Glazing: Subject to compliance with requirements, obtain safety glazing products permanently marked on each individual glass lite with certification label of manufacturer acceptable to authorities having jurisdiction. Safety glazing shall conform to ANSI Z97.1, Safety Performance Specification, and ANSI Z97.1, Safety Glass Code., and IBC 2406.1 as applicable.
2. Glass Types: (As shown or required)
 - a. Type G-1: 1 inch thick insulating glass units comprised of a 1/4 inch thick glazing quality Low-e tinted tempered float glass exterior lite with a 1/4 inch thick glazing quality clear tempered float glass interior lite, separated by a 1/2 inch air space. Color shall be Solarban 70XL "Starphire/Clear" manufactured by PPG Industries, or Architect approved equal at all exterior locations typical, except where indicated otherwise and having the following properties:

- 1) Visible Light Transmittance (%): 64
 - 2) Winter Night-time U-value: 0.28
 - 3) Shading Coefficient: 0.32
 - 4) Light to Solar Gain Ratio (LSG): 2.37
 - b. Type G-2: 1 inch thick insulating glass unit compressed of a $\frac{1}{4}$ inch thick spandrel glass with a colored lead free ceramic frit, fire floed to LTS interior surface to match Type G-1 above interior lite with a $\frac{1}{4}$ " exterior lite to match G-1, separated by a $\frac{1}{2}$ inch air space.
 - c. Type G-3: 1/4 inch thick glazing quality, clear float glass.
 - d. Type G-4: 1/4 inch thick glazing quality, clear, tempered float glass.
 - e. Type G-5: Acoustical Glass consisting of one (1) lite of 1/4 inch thick tempered glass and one (1) lite of 3/8 inch thick laminated clear float glass comprised of two (2) 3/16 inch thick glazing quality clear float glass lites, laminated to each side of a clear 0.030 inch thick polyvinyl butyral(PVB) interlayer. Install in sound retardant doors as shown on drawings in Music Rooms provided under Section 08 34 73.
 - f. Type G-6: 5/16 inch, ceramic, premium clear fire rated glass; 60 minute, listed and labeled for hose stream and positive pressure. Rated for impact safety in accordance with CPSC 16CFR 1201 Cat. II (400 foot pounds).
- G. Aluminum and Glass Entrance Doors: Kawneer Co., Inc., "Series 500 Wide Stile" Swing Door Standard Entrance or equivalent product from list of approved manufacturers.
1. Doors: Shall be 1-23/32 inch thick, consisting of 5 inch vertical stile, 5 inch top rail and 10 inch bottom rail aluminum tubular sections with 0.125 inch thick nominal wall thickness to comply with 2012 TAS Section 404.2.10.
 2. Connections:
 - a. Provide bolted and welded connections, fit to a hairline joint.
 - b. Provide reinforcing at bolted attachments. Tapped aluminum is not permitted.
 - c. Provide concealed screws, nuts, bolts, and anchors, except hardware screws on butt of door, of non-corrosive metal.
 3. Glass in Door: Type G-1 at all exterior locations. Deliver doors to job pre-glazed.
 4. Glazing Gaskets: Use manufacturer's recommended gaskets for flush glazing (color: Black).
 5. Mullion Stabilizer: Provide as required at double acting doors with removable mullion.
 6. Hardware: Refer to Section 08 71 00, Finish Hardware.
- H. Aluminum Storefront/Entrance Framing System: Kawneer Co., Inc., "TRIFAB VG 451 (VersaGlaze)", typically; or equivalent product from list of approved manufacturers:
1. Size 2 inch by 4-1/2 inch flush glazed type (typical).
 2. Provide mullion reinforcement, if necessary, to achieve structural requirements.
 3. Glass Pockets: Shall be sized to accept specified glass.
 4. Provide sill receptors with end dams. (At all sill conditions.)
- I. Aluminum Curtain Wall System: Kawneer Co., Inc., 1601 Series or equivalent product from list of approved manufacturers:
1. Structural Properties:
 - a. Limit the dead load deflection of horizontal members supporting glass to 1/175 of the clear span with a 1/8 inch maximum deflection.
 - b. Limit the deflection of any member in a direction parallel to the plane of the wall and of any corner mullion in both parallel and perpendicular directions to a maximum of 25 percent of the glass bite dimension and maintain a minimum of 1/8 inch clearance between the member and the edge of the glass, panel, or other component.
 - c. Limit the wind load deflection of any member to 1/240 plus 1/4 inch of the clear span, based on "pinned" ends.
 - d. Limit the wind load deflection of corner mullions to the span as specified above, with the specified pressure acting on one face of the building with no pressure acting on

- the adjacent face, or 1/2 the specified pressure acting on one face of the building with 1/2 the specified suction acting on the adjacent face, whichever is the greatest.
- e. No wall element shall sustain permanent deflection of glass breakage under maximum design load.
 - f. The panels and their connections shall accommodate movements of the structure resulting from lateral forces. Provide connections with sufficient ductility to preclude brittle failure, at or near, welds.
 - g. Framing Sizes: 2-1/2 inches x 6-3/4 inches where indicated on the drawings. Miter ends of horizontals to form segmented curve at commons.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Obtain hardware templates from finish hardware supplier.

3.02 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Clean glazing channels, stops, and rabbets to receive the glazing materials, making free from obstructions and deleterious substances which might impair the work.
 - 1. Remove protective coatings which fail in adhesion or interfere with bond of sealants.
 - 2. Comply with manufacturers' instructions for final wiping of surfaces immediately prior to application of primer and glazing compounds or tapes.
 - 3. Prime surfaces to receive glazing compounds in accordance with manufacturer's recommendations.

3.03 INSTALLATION

- A. Inspect each piece of glass immediately prior to start of installation.
 - 1. Do not install items which are improperly sized, have damaged edges, or are scratched, abraded, or damaged in any other manner.
 - 2. Do not remove labels from glass until so directed by the Architect.
 - 3. Install glass so distortion waves, if present, run in the horizontal direction.
- B. Locate setting blocks at sills one quarter of the width of the glass in from each end of the glass, unless otherwise recommended by the glass manufacturer.
 - 1. Use blocks of proper size to support the glass in accordance with the manufacturer's recommendations.
 - 2. Provide spacers for all glass sizes larger than 50 united inches, to separate glass from stops; except where continuous glazing gaskets or felts are provided.
 - a. Locate spacers no more than 24 inches apart, and no closer than 12 inches to a corner.
 - b. Place spacers opposite on another.
 - c. Make bite of spacer on glass 1/4 inch or more.
- C. Set glass in a manner which produces the greatest possible degree of uniformity in appearance.
- D. Do not use two (2) different glazing materials in the same joint system unless the joint use is approved in advance by the Architect.
- E. Mask, or otherwise protect, surfaces adjacent to installation or sealants.
- F. Install all glass, gasket, and aluminum framing in accordance with manufacturer's printed instructions. Installed windows units shall conform to AAMA 502 minimum requirements for air and water infiltration.
- G. Caulk joints where indicated to meet performance specifications using materials specified in Sealants section. Follow sealant manufacturer's printed instructions for the installation of his product.

H. Erection Tolerances:

1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.
5. Maximum Openings Between Movable Glazing Stop and Adjacent Member: 1/32 inch.

3.04 PROTECTION AND ADJUSTMENTS

- A. Protect glass from breakage after installation by promptly installing streamers or ribbons, suitably attached to the framing and held free from glass. Do not apply warning markings, streamers, ribbons, or other items directly to the glass except as specifically directed by the Architect.
- B. Adjust windows as necessary for smooth and weather tight operation, and leave windows clean and free of construction debris.

END OF SECTION

SECTION 08 9100
PRE-FINISHED ALUMINUM LOUVERS

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's printed specifications and product data.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawing: Show sizes, locations and installation details.
- C. Samples: Color samples for Architect's selection.

1.02 REFERENCES

- A. Architectural Aluminum Manufacturer's Assn. (AAMA)
 - 1. Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

1.03 WARRANTY

- A. Warrant the work specified herein for 20 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Fading, corrosion, or other finish deterioration.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER/PRODUCT

- A. Specifications are based on Model ESD-435, fixed extruded aluminum louver manufactured by Greenheck. Manufacturers listed whose products are equivalent to those specified are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Construction Specialties, Inc.; www.c-sgroup.com.
 - 2. Ruskin; www.ruskin.com.
 - 3. Greenheck, Schofield, WI; www.greenheck.com

2.02 MATERIALS

- A. Wall Louvers:
 - 1. Head, Sills, and Jambs Material: Shall be one (1) piece structural members of
 - 2. 0 inch thick 6063-T5 alloy with integral caulking slot and retaining bead.
 - 3. Blade Material: Shall be one (1) piece structural members of 0.080 inch thick 6063-T5 alloy.
 - 4. Blade Style: Drainable.
 - 5. Blade Angle: 37.5 degrees
 - 6. Blade Centers: 5-3/32 inch.
 - 7. Frame Depth: Four (4) inches.
 - 8. Size: As indicated on Architectural drawings.
 - 9. Required Free Area: As indicated on Mechanical drawings.
 - 10. Structural Supports: Shall be designed by the manufacturer to carry a wind load of not less than 25 lbs. per square foot.
 - 11. Fasteners: Concealed type of stainless steel.
 - 12. Bird Screen: 3/4 inch x 0.051 inch diameter aluminum wire mesh, crimped in extruded frame.
 - 13. Louver Finish: Kynar 500 or Hylar 5000 finish meeting or exceeding AAMA 605.2 in color selected by Architect from manufacturer's available colors.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on approved shop drawings.

3.02 INSTALLATION

- A. Apply one (1) coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.
- B. Install louvers in locations shown on drawings in accordance with manufacturer's printed instructions.
- C. Install level and plumb.
- D. Secure in place with concealed fasteners.

END OF SECTION

SECTION 09 2116
GYPSUM WALLBOARD SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Metal wall and ceiling framing for gypsum board construction.
- B. Exterior Sheathing.
- C. Gypsum Wallboard.
- D. Gypsum Wallboard Accessories
- E. Cement Tile Backer Board.
- F. Moisture Resistant Tile Backer Board.
- G. Taped, filled and sanded joint treatment.
- H. Textured finish system.

1.02 RELATED WORK

- A. Section 05 4000 - Cold Formed Metal Framing
- B. Section 07 2620 - Fluid Applied Air Barrier System
- C. Section 07 2100 - Building Insulation
- D. Section 07 8400 - Firestopping and Fire Safing
- E. Section 07 9200 - Building Sealants
- F. Section 09 3013 - Ceramic Tile
- G. Section 09 9100 - Painting and Staining

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification: Manufacturer's affidavit that materials used contains no asbestos.

1.04 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 3113 – Project Coordination.

1.05 REFERENCES

- A. ASTM International (ASTM)
 - 1. C1396/C1396M, Standard Specification for Gypsum Wallboard
 - 2. C645-08, Standard Specification for Nonstructural Steel Framing Members
 - 3. C754-07, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
 - 4. C840, Standard Specification for Application and Finishing of Gypsum Board
 - 5. C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness
 - 6. C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - 7. C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 - 8. C1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - 9. C1280, Standard Specification for Application of Gypsum Sheathing
 - 10. D3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

- B. Gypsum Association (GA)
 - 1. 216, "Recommended Specification for the Application and Finishing of Gypsumboard"
- C. SS-L-30

1.06 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. In addition, provide warranty from the manufacturer for the following products:
 - 1. Exterior sheathing weathering warranty covering in-place exposure damage to exterior sheathing for twelve (12) months.
 - 2. Exterior sheathing warranty against manufacturing defects for five (5) years.
 - 3. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six (6) months.
 - 4. Abuse Resistant Panel warranty against manufacturing defects for three (3) years.
 - 5. Glass-mat sheathing weathering warranty covering in-place exposure damage to sheathing for three (3) months.
 - 6. Glass-mat sheathing warranty against manufacturing defects for three (3) years.
 - 7. Tile backer board warranty against manufacturing defects for 20 years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Where products are named in the specifications, they are considered basis of specification. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered. All gypsum wallboard must be U.S. produced.
 - 1. Gypsum Wallboard and related products and materials:
 - a. CertainTeed
 - b. G-P Gypsum Corporation (Georgia Pacific)
 - c. James Hardie Building Products, Inc.
 - d. National Gypsum Company (Gold Bond)
 - e. United States Gypsum Company (USG)
 - f. Dietrich Metal Framing
 - 2. Aluminum Moldings:
 - a. Fry Reglet Corporation
 - b. MM Systems Corporation
 - 3. Deflection Track and related products and materials:
 - a. Fire Trak Corp.
 - b. The STEEL Network, Inc.
 - c. Dietrich Metal Framing
 - 4. Moisture protection (Interior)
 - a. Waterguard.

2.02 MATERIALS

- A. Metal Framing System:
 - 1. Studs:
 - a. Meeting requirements of ASTM C645-08; C-channel, roll-formed from hot-dipped galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating. Channel type screw studs roll formed from 25 gauge galvanized steel, unless otherwise shown on drawings. Provide channel type screw studs roll formed from 20 gauge (I/360) galvanized steel at walls to receive tile.
 - b. Widths shall be as indicated on drawings.

- c. Section modules for studs shall be S = 0.135 for 3-5/8 inch studs, and S 1) 82 for 2-1/2 inch studs.
 - 2. Tracks:
 - a. Meeting requirements of ASTM C645-08; C-channel, roll-formed from hot-dipped galvanized steel; complying with ASTM A1003 and ASTM A653 G40 or equivalent corrosion resistant coating
 - b. Widths shall be as indicated on drawings.
 - c. Deflection Track (DT) (Non-rated walls): Use deflection track at walls extending to structure to allow for movement. Deflection track shall allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track.
 - d. Deflection Track and Firestop System (At fire rated walls): Contractor shall use a deflection track and firestop system at heads of fire rated partitions. System shall use "Shadowline" deflection track, mineral fiber, sealant, clips, and accessories required to achieve fire ratings shown or required by authorities having jurisdiction. System shall comply with Deflection Track and Firestop System manufactured by Fire Trak Corp., Kimball, MN; (800) 394-9875, Dietrich Metal Framing; SLP-TRK® Slotted Deflection Track by Brady Innovations or equal or comparable products manufactured by The STEEL Network, Inc., Raleigh, NC; (919) 845- 1025, or Architect approved equal.
 - e. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of .0538 inch (1.37mm) and minimum 1/2 inch wide flanges.
 - f. FLAT STRAP AND BACKING PLATE: Sheet for blocking and bracing in length and width indicated:
 - (a) Subject to compliance with requirements, provide Dietrich Metal Framing: Danback™ Fire Treated Wood Backing Plate
 - (b) Galvanized Sheet Steel.
 - 3. Comply with applicable reference standards.
 - 4. Refer to Section 05 40 00 for light gauge steel framing for 18 gauge and heavier runners and other framing as shown or required.
- B. Drywall Suspension System (If shown or required): Pre-engineered drywall suspension system specially created to simplify the design and construction of flat drywall ceilings. Approved Product/Manufacturer: USG Drywall Suspension System manufactured by USG Interiors, Inc., or Architect approved equal.
- C. Wall and Ceiling Materials:
- 1. Exterior Sheathing: ASTM C1177; 1/2 inch thick water resistant treated gypsum core, glass mats both front and back faced or embedded in core, weather resistant surface, zero flame spread, zero smoke developed. Approved Product/Manufacturer: "Dens-Glass Exterior Sheathing" manufactured by Georgia-Pacific; "GlasRoc" manufactured by CertainTeed; "Securock" manufactured by USG; "Gold Bond e2XP" manufactured by National Gypsum. Use as exterior sheathing in metal stud framed construction behind face brick in cavity wall construction, and behind plaster.
 - 2. Gypsum Wallboard:
 - a. Wallboard: 5/8 inch thick, tapered-edged, conforming to ASTM C1396, Type X. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints.
 - b. Moisture Resistant: 5/8 inch thick, moisture resistant (MR), green faced, tapered-edged, conforming to ASTM C1396. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints. Provide fire rated core where required to maintain fire rating of adjacent assembly.
 - 3. Gypsum Shaft Liner: One (1) thick gypsum core for added fire resistance and multi-layered green paper facings that are treated to resist moisture penetration.
 - 4. Cement Tile Backer Board (Wet areas): 1/2 inch thick, "G-P Dens-Shield Tile Guard", Bonsal "Util-A-Crete", "USG Durock", Custom Building Products "Wonderboard", "National Gypsum Permabase", or Architect approved equal. Use as sheathing at shower areas and restrooms, or as scheduled on walls to receive ceramic tile in other wet areas. Use

greatest width by longest practical length to minimize joints. Use joint reinforcement and fasteners in accordance with manufacturer's printed instructions. For fiber and cement backer boards, provide waterproof membrane behind backer board per TCA W244. Coated glass-mat water-resistant gypsum board does not require waterproofing membrane per TCA W245.

5. Moisture Resistant Tile Backer Board (Dry areas): 1/2 inch thick, "Fiberock Brand 'Aqua-Tough' Gypsum Interior Panels" as manufactured by USG Corporation; "DensArmor Interior Guard Plus" manufactured by G-P Gypsum Corp, or Architect approved equal.
6. Channels: 16 gauge cold formed steel channels with hot dip galvanized finish. Sizes as indicated on drawings. Use for suspended ceilings and elsewhere as indicated.
7. Furring Channels: Standard 2-3/4 inches wide, 7/8 inch deep galvanized sheet metal furring channel.
8. Corner Beads: No. 28 gauge galvanized steel, 1-1/4 inch legs. Use at all exterior corners.
9. Joint Compound: Standard types manufactured by gypsum wallboard manufacturer for intended use. Fire rated type must be used on fireproof systems. Perlite and other additives not permitted.
10. Laminating Adhesives: Standard type manufactured or recommended by manufacturer of product to be laminated.
11. Acoustic Sealant: Single component, non-skimming, non-hardening synthetic rubber for use in the acoustical sealing of gypsum board partitions. STC rating as required by drawings in accordance with manufacturers instructions to achieve rating. Approved Products and Manufacturers: Tremco Acoustical Sealant manufactured by Tremco Sealant/Weatherproofing Division, Beachwood, OH; (800) 321-7906, or Architect approved equal.
12. Ceiling Hanger and Tie Wire: 9-gauge galvanized hanger wire and 16 gauge tie wire.
13. Screws: One (1) inch and 1-5/8 inch long self drilling, self tapping cadmium plated bugle head type. Comply with applicable reference standards.
14. Resilient Clips: Standard type for resilient installation in accordance with wallboard manufacturer's recommendations.
15. Control Joints: Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.
16. Wall Fixture Reinforcement: 6 inches, 14 gauge cold formed steel galvanized channels.
17. Glass-fiber Mesh Tape: minimum 2 inch wide self-adhering glass-fiber type, 10X10 threads per inch.
18. Silicone Joint Sealant: ASTM C920, Type S, grade NS, compatible with exterior sheathing tape and sheathing, instructed by tape and sheathing manufacturers for use with glass-fiber mesh sheathing tape and for covering exposed fasteners.
19. Waterproof membrane under cementitious/fiber tile backer board shall be minimum 15-pound building felt or 4-mil polyethylene film in accordance with ANSI A2.1.8.
20. Textured Finish Materials: Latex-based compound; plain.
21. Furnish all necessary labor, material, and equipment for complete installation of Waterguard moisture protection device as shown on drawings and/or specified herein.

PART 3 - EXECUTION

3.01 EXTERIOR SHEATHING INSTALLATION

- A. Furnish exterior sheathing where indicated on drawings and install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253 and ASTM C1280, without openings, gaps, cracks, or holes.
- B. Attach sheathing to metal framing with gold side out and with screws spaced eight (8) inches on center at perimeter where there are framing supports and eight (8) inches on center along intermediate framing in field.
- C. Use maximum lengths possible to minimize number of joints.
- D. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.

- E. Locate fasteners minimum 3/8 inch from edges and ends of sheathing panels.
- F. Apply continuous dampproofing as specified in Section 07 1100, Dampproofing Above Grade. Prep exterior sheathing per manufacturer's instructions.

3.02 INTERIOR METAL FRAMING INSTALLATION

- A. Steel Framing Installation Standard: Comply with ASTM C754.
- B. Floor Track: Attach to floor at 24 inches maximum centers with shoot-in pins or concrete nails.
- C. Ceiling Track: Fasten at 24 inch intervals, staggered. Where shown or required to extend above ceiling, brace to the structure at intervals not exceeding 4 feet-0 inches.
- D. Deflection Track (DT): Deflection track shall allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track. At fire rated walls, Contractor's shall use the specified deflection track with firestop systems.
- E. Drywall Suspension System: Use at gypsum drywall suspended ceilings, where shown or required.
- F. Metal Studs:
 - 1. Single lengths positioned vertically straight and plumb in the runners, spaced 16 inches on center, unless shown otherwise on drawings.
 - 2. Anchor all studs located adjacent to door and window frames, partitions intersections and corners to runner flanges by positive screw engagement through each stud flange and runner flange.
 - 3. Position all studs vertically with the open side facing in the same direction, engaging the floor and ceiling runners.
 - 4. Use positive screw attachments with 3/8 inch or 1/2 inch Type "S" or "S-12" pan head screws through each stud flange and runner flange.
- G. Wall Fixture Reinforcement: Provide solid bridging spanning between wall studs at all wall mounted fixtures, finish hardware, toilet partitions, accessories and equipment.

3.03 GYPSUM WALLBOARD INSTALLATION

- A. Apply all ceiling boards first as described below. Cut boards so that they slip easily into place. Butt all joints loosely. Never force panels into position. Place tapered or wrapped edges next to one another.
- B. Select the maximum practical length to minimize end joints. All end joints shall be neatly fitted and staggered. Joints on opposite sides of partition shall be so arranged as to occur on different studs.
- C. Never place a butt end or a cut edge next to a tapered or rounded edge. Wherever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.
- D. Support all ends and edges of gypsum board on framing, except long edges at right angles to framing and where end joints are to be floated between frame members and back-blocked.
- E. When fastening, apply hand pressure on panel next to fastener being driven to insure panel is in tight contact with framing member.
- F. Install metal corner bead at external corners. Where length of the corner does not exceed standard stock lengths, use a single length.
- G. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture.
- H. Install metal trim where indicated.
- I. To insure level surfaces at joints, arrange board application so that the leading edge of each board is attached to the open or unsupported edge of a steel stud flange. To do this, all studs must be placed so that their flanges point in the same direction. Board application is then planned to advance in the direction opposite to flange direction.

- J. The leading edge of gypsum board shall not be attached to the web edge of a flange.
- K. Fasten wallboard at 12 inches on center except at the edges/joints which shall be at 8 inches on center
- L. Edge-Grip Clips: Position clips on the back of the panels and drive prongs into panel edges. Space clips 16 inches on center Screw-attach clip to framing, furring or wall surface.
- M. Apply at least two (2) coats of joint compound over beads, screw heads and trim, and each coat shall be feathered out onto panel faces.
- N. Float out and sand joints to make joints invisible when painted with non-texture paint.
- O. Caulk around pipes, ducts, structure or similar items which penetrate drywall systems.
- P. Provide acoustical sealant at walls in accordance with manufacturer's instructions.
- Q. Control joints shall be located 30'-0" on center maximum, along building expansion joints, and above/below each side of every opening, in addition to any specifically shown in drawings. Locations shall be reviewed with Architect prior to final placement.

3.04 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.05 CONTROL JOINTS

- A. Place control joints over each side of every door or group of doors.
- B. Place control joints over each side of every window or group of windows.
- C. Place control joints every forty feet of continuous wall length when not interrupted by doors or windows.

3.06 TEXTURE FINISH

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions to a medium orange peel texture.

3.07 CEMENT TILE BACKER BOARD INSTALLATION – WET AREAS

- A. Install tile backer on walls vertically or horizontally.
- B. Coated Glass Mat Backer Boards: Install tile backer directly on metal stud framing system in showers and other wet areas in accordance with manufacturer's recommendations and TCA, Methods W245 at walls and B420 for shower installations.
- C. Cementitious/Fiber Backer Boards: Install tile backer on approved waterproof membrane in showers and other wet areas in accordance with manufacturer's recommendations and TCA, Methods W244 at walls and B419 for shower installations.
- D. Finishing:
 - 1. Substrate for tile: Apply clear silicone sealant to corners and board joints. Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Seal penetrations with setting material or silicone sealant. Allow joints and penetrations to dry prior to installing tile systems.

3.08 MOISTURE RESISTANT TILE BACKER BOARD INSTALLATION – DRY AREAS

- A. Install tile backer on walls vertically or horizontally.

- B. Install tile backer on walls in accordance with manufacturer's recommendations and TCA, Method W245.
- C. Finishing:
 - 1. Substrate for tile: Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Allow joints to dry prior to installing tile systems.

3.09 CEILING FRAMING INSTALLATION

- A. Main Runners: 9-gauge hanger wires shall be spaced not over 4 feet-0 inches in the direction of 1-1/2 inch main runner channels and not over 4 feet-0 inches in the direction of right angles to the main runners, and within 6 inches of the ends of main runners and of boundary walls, girders or similar interruptions of ceiling continuity. Do not hang wire supports from metal deck unless directed to do so by Architect or Structural Engineer. Main runners shall be spaced not over 4 feet-0 inches on center.
- B. Cross tees shall be spaced in accordance with manufacturer's recommendations or in conformance with UL Fire Resistance Directory.
- C. Furring Channels: Space 16 inches on center, and saddle-tie with two strands of 16-gauge tie wire to main runners or main support members. Do not let into or come in contact with abutting masonry walls. End splices shall be provided by nesting channels or studs no less than 8 inches and securely wire-tie.
- D. Drywall Suspension System: Install where indicated in accordance with manufacturer's instructions.
- E. Provide control joints in ceiling at maximum 30 feet on center and, if possible, to coincide with expansion joints in the roof above.

3.10 CEILING BOARD INSTALLATION

- A. Apply gypsum board of maximum practical length with the long dimension at right angles to the furring channel and fastened with one (1) inch drywall screws spaced 12 inches on center in the field of the board and along abutting ends.
- B. Align abutting end or edge joints over the web surface of the furring channel. Tie neatly and accurately with end joints staggered.
- C. Install gypsum board ceiling panels in drywall suspension system.
- D. Joint treatment, control joint, and texture finish requirements shall be the same as the walls.

3.11 WORKMANSHIP TOLERANCES

- A. Visual: Correct any nicks, bumps, out-of-level or out - of-plumb areas detectable to the naked eye.
- B. Walls: 3/8 inch maximum deviation from vertical.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.
- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

3.12 COMMENCEMENT RESTRICTIONS

- A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

END OF SECTION

SECTION 09 3019 PORCELAIN TILE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Thin set porcelain tile, mortar and grout, sealants, and accessories shown or required to complete work.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's printed installation instructions.
- B. Samples:
 - 1. Selection: Submit samples of the complete tile color line, patterns, textures and finishes, and grout colors for Architect's selection.
 - 2. Approval: Submit samples of selected tile mounted on 24 inch x 24 inch board indicating joint size and grout.
- C. Certifications:
 - 1. Provide Master Grade Certificate as specified in ANSI A137.1.
 - 2. Manufacturer's affidavits that materials used contain no asbestos.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. Installation Specifications:
 - a. 5, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
 - b. 10, Installation of Grout in Tilework
 - 2. Material Specifications:
 - a. 4, Latex-Portland Cement Mortar
 - b. 6, Ceramic Tile Grouts
 - c. 1, Ceramic Tile
- B. Tile Council of America, Inc. (TCA)
 - 1. Handbook for Ceramic Tile Installation

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Specifications are based on products of manufacturers specified. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.
 - 1. Porcelain Tile:
 - a. American Olean Tile Co., Dallas, TX; (214) 398-1411
 - b. Dal-Tile Corp., Dallas, TX; (713) 481-5893
 - 2. Tile Setting and Grout Materials: Those manufactured by any one (1) of the following. No substitutions.
 - a. Dal-Tile Corp., Dallas, TX; (713) 481-5893
 - b. Laticrete International, Inc., Bethany, CT; (800) 243-4788
- B. Specifications are based on porcelain tile as manufactured by Interceramic, USA. Other manufacturers listed shall provide colors and finish equivalent to those specified.

2.02 MATERIALS

- A. Floor Tile: Size and type as shown on Drawings.
 - 1. Color: As shown on Drawings.
 - 2. Finish: As shown on Drawings.

3. Locations: Each type shall be as shown on drawings.
 4. Base: Six (6) inch high porcelain tile base to match porcelain tile.
 5. Borders and Patterns: As shown on Drawings
- B. Wall Tile: Size and type as show on Drawings.
1. Color: As shown on Drawings.
 2. Finish: As shown on Drawings.
 3. Locations: Each type shall be as shown on drawings.
 4. Base: Six (6) inch high porcelain tile base to match porcelain tile.
 5. Borders and Patterns: Moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.
- C. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, or 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp., Dallas, TX; (800)-933-8453, Ultraflex 3 as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734. No substitutions.
- D. Epoxy Grout: Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. ARDEX L.P., WA Epoxy Grout, Aliquippa, PA (724) 203-5000
 2. Polyblend® Tile Grout with 100 percent Solids Epoxy manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808.
 3. LATICRETE® SpectraLOCK PRO Stainless Grout manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788.
 4. Kerapoxy IEG, 100% Solids, Industrial-Grade Epoxy Grout manufactured be Mapei Americas, Deerfield Beach, FL; (800)-426-2734.
- E. Crack Isolation Membrane:
1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
 - a. Dalseal CIS manufactured by Dal-Tile.
 - b. Crackbuster manufactured by Custom Building Products.
 - c. Mapelastic SM manufactured by Mapei.
 - d. Nobleseal CIS manufactured by The Noble Company.
 - e. Tileguard manufactured by Polyguard Products, Inc.
 2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
 - a. Blue 92 manufactured by Laticrete International, Inc.
 - b. Fracturefree manufactured by Custom Building Products
- F. Expansion Joint:
1. Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
 2. Typical Conditions except as specified below: Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.
 3. Conditions exposed to chemicals, food processing, etc.: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.
- G. Latex Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by ARDEX ENGINEERED CEMENTS Aliquippa, PA; (724) 203-5000. No substitutions.
- H. Edge Protection and Transition Strips:

1. Porcelain Tile to Gyp. Bd.: Schluter□ - QUADEC transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.
2. Schluter□ - QUADEC transition strips in aluminum finish at all porcelain tile wall outside corner locations.
3. Porcelain Tile to Carpet: Schluter□ - SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.
4. Porcelain Tile to Sealed Concrete: Schluter□ - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
5. Schluter□ - TREP-S GS 10 S, aluminum support with thermoplastic rubber insert.
6. Approved Manufacturer: Schluter□ Systems LP, Plattsburg, NY; (800) 472-4588.
7. Provide all corners and connectors as required for a complete and detailed finished installation.

2.03 EXTRA TILE

- A. Deliver four (4) unopened boxes of tile of each color tile and base from the same tile production run to the Owner at Substantial Completion.

PART 3 - EXECUTION

3.01 PREPARATION

- A. By General Contractor:
 1. Protect surrounding work from damage or disfiguration.
 2. Vacuum clean and damp clean existing substrate surfaces.
- B. By Tile Contractor:
 1. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.
 2. Examine substrates defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
 - a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
 - b. Well cured, firm and level within TCA specified tolerances.
 - c. Minimum of 40 degrees F and rising.
- C. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.02 INSTALLATION

- A. Crack Isolation Membrane:
 1. Install crack isolation membrane under tile over building control joints and substrate cracks up to 1/8 inch. Apply a 30 inch wide strip centered on control joint or crack. Install in accordance with TCA F125 and manufacturer's instructions.
 2. Install joint sealant in joint of first tile on both sides of control joint and crack.
 3. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
- B. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.
- C. Install porcelain pavers over crack isolation membrane in locations shown on drawings in accordance with TCA F125 and ANSI A108.5 recommendations and manufacturer's instructions.
- D. Do not use damaged porcelain tile, including those with broken or cracked edges.
- E. Lay out all work so that, where possible, no tiles less than half size occur.
- F. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.
- G. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.
- H. Install edge protection and transition strips in accordance with manufacturer's instructions.

- I. Damp cure grout in accordance with manufacturer's recommendations. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.

3.03 CLEANING AND PROTECTION

- A. Clean work at completion of installation, remove excess grout from porcelain tile surfaces. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
- B. Remove grout from adjacent finish surfaces.
- C. Protect finished installation until final acceptance.
- D. Do not permit traffic over finished floor surface.

3.04 REPAIR

- A. Repair or replace damaged porcelain tile, including those with broken or cracked edges at no expense to Owner.

END OF SECTION

SECTION 09 6513 RESILIENT BASE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Resilient base, adhesive attached, in locations shown on drawings.

1.02 REFERENCES

- A. ASTM International (ASTM)
 - 1. F1861, Standard Specification for Resilient Wall Base

1.03 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors, for Architect's selection (if selections are not already scheduled otherwise indicated on the drawings).
 - 2. Actual 12-inch-long piece of base material in each color selected for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers named first are basis of Specification. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

2.02 MATERIALS

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere):
 - 1. Quality Standard: ASTM F1861.
 - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
 - 3. Type: Topset cove; 48 inch lengths. No rolls permitted.
 - 4. Thickness: Full 0.125 (1/8) inch.
 - 5. As scheduled or otherwise indicated on the drawings, or if not so indicated, as selected by Architect.
 - 6. Height: Four (4) inches, unless indicated otherwise.
 - 7. Approved Products/Manufacturers: Burke Flooring, Flexco, Nora Rubber Products, Roppe Corp., or Architect approved equal.
- B. Extended (Sanitary) Toe Rubber Base (at athletic flooring or elsewhere, if and where indicated):
 - 1. Quality Standard: Same as above.
 - 2. Material: Rubber.
 - 3. Type: Sanitary Cove with two (2) inch toe; 48 inch lengths.
 - 4. Thickness: 1/8 inch thick with a 0.125 inch thick toe.
 - 5. Color: Black.
 - 6. Height: Four (4) inches.
 - 7. Approved Product/Manufacturer: Extruded Rubber Cove Base with Sanitary Toe manufactured by Roppe Corp., or Architect approved equal.
- C. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.

- D. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.03 EXTRA STOCK

- A. Deliver to the Owner:
1. percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
 2. One (1) gallon container of each type adhesive used for base.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to the Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Prepare substrates to receive base as recommended by base manufacturer.
- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

3.03 INSTALLATION

- A. General:
 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
 1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

3.04 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 6813 TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL:
Reclamation/Recycling of new carpet tile scrap.
- C. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- C. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.
- D. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit one full size carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Manufacturer's Installation Instructions: Indicate special procedures.
- E. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 EXTRA MATERIALS

- A. See Section 01 6000 - Product Requirements, for additional provisions.
- B. Provide 2 boxes of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 MATERIALS

- A. Tile Carpeting, Type CPT1: Tufted, manufactured in one color dye lot.
 - 1. Product: Cubic 4292 Area manufactured by Interface
 - 2. Tile Size: 24 inch x 24 inch, nominal.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, color as selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Verify that concrete sub-floor surfaces are ready for carpet tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- B. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- D. Blend carpet from different cartons to ensure minimal variation in color match.
- E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- G. Locate change of color or pattern between rooms under door centerline.
- H. Fully adhere carpet tile to substrate.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 9100
PAINTING AND STAINING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation and field application of paints and stains on interior substrates where shown or required.
- B. Surface preparation and field application of paints and stains on exterior substrates where shown or required.
- C. Surfaces not included, as applicable to the project, include, but are not limited to the following:
 - 1. Areas above finished ceiling or scheduled "unpainted" on the Finish Schedule of the drawings, except for those items within those spaces scheduled to painted.
 - 2. Exposed concrete, unless noted otherwise.
 - 3. Shop coat of paint on metal, except for damaged shop primer touch-up (unless noted otherwise).
 - 4. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, is included.)
 - 5. Factory finished items other than prime painted to be field paint finished.
 - 6. Glass and glass masonry.
 - 7. Sealants of types which should not be painted and to which paint will not adhere.
 - 8. Plastic laminate items, such as doors, countertops, casework, etc.
 - 9. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
 - 10. Stainless steel items.
 - 11. Ceramic or tile of any kind.
 - 12. Valves and controls.
 - 13. Name plates on equipment.
 - 14. Fire rating labels, including those on fire rated doors and frames.
 - 15. Finish hardware, except that which is factory primed and designated as "BHMA 600", if any, in Finish Hardware Section.
 - 16. Existing construction, unless noted otherwise.
 - 17. Materials not noted to be refinished or to receive a finish, except as noted, including, but not limited to the following:
 - a. Roofing
 - b. Asphalt paving, except for parking and lane striping, fire lane, and "wheel chair" handicapped access parking spaces.
 - c. Concrete paving and curbs, except for parking and lane striping, fire lane, and "wheel chair" accessible parking spaces.
 - d. Flooring, except those to receive game striping, or as noted.
 - 18. Color coding of Mechanical Room pipes whether insulated or not: (Unless noted or directed otherwise)

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. D16, Standard Terminology for Paint, Related Coatings, Materials and Applications.

1.03 DEFINITIONS

- A. Conform to definitions of terms in ASTM D16 in interpreting requirements of this Section.

1.04 SUBMITTALS

- A. Material lists. Give the supplier's name, product name, number and generic description of each proposed product and its use. Provide product data sheets if so requested.
- B. Samples. Submit full range of colors, patterns, textures and finishes available for selection, including the following:

1. Color Chips: Provide complete duplicate sets of color chips for color selection.
2. Small Applied Samples: Provide pieces of actual material on which paint will occur with minimum dry mil thickness of specified paint. Provide painted 12 inch x 12 inch actual gypsum wallboard samples with approved textures for Architect's approval. Approved samples will become standard for which all work will be judged.
3. Sheen Samples: Provide full range of varying sheens when sheens are controllable by intermixing.
- C. Installed Samples. Provide large size samples for approval. Approved samples may be left in place as part of the work.
- D. One room and/or area, as selected by the Architect, shall be painted with materials specified or accepted and applied directly from container, unthinned. After acceptance by Architect, room and/or area shall be standard of quality of entire project.
- E. Certification. Furnish a letter certifying that materials submitted are truly equivalent or better than those called out in the finish schedule.

1.05 RESPONSIBILITY OF COORDINATION

- A. Coordinate the work specified herein with the following work:
 1. Provide information to preceding trades for proper preparation of substrate.
 2. Inspect substrate before proceeding to verify proper preparation.
 3. Notify Architect of any item to receive paint which may not be covered by a scheduled finish type. Architect will furnish appropriate specification.

1.06 QUALITY ASSURANCE

- A. Materials:
 1. Delivery and Storage: Products shall be delivered to jobsite in unopened containers bearing manufacturer's labels intact and legible at time of use. Storage shall be in designated areas away from excessive heat and open flames and in accordance with manufacturer's recommendations.
 2. Quality or Grade:
 - a. Paints and coatings shall be the manufacturer's highest professional quality material of types specified and shall be applied directly from containers in which material is purchased, except where thinning is recommended by manufacturer and approved by Architect to suit intended use, i.e. painting acoustical tile or panels without destroying their acoustical properties.
 - b. Primers and other undercoat paints shall be those produced by same manufacturer as finish coats.
 - c. Thinners shall be those recommended by paint manufacturer's printed instructions.
 3. Equipment:
 - a. Spray Equipment: Shall be the type recommended for the application and shall be maintained clean and in proper working order.
 - b. Brushes, Rollers, etc.:
 - 1) Shall be new of the various sizes and types recommended for each application.
 - 2) Shall be properly cleaned and stored in accordance with manufacturer's instructions at the end of each days' use.
 - 3) Shall be replaced as often as necessary to attain the best finish quality in the Work.
 4. Application:
 - a. Applicator:
 - 1) Shall be person(s) or entity specializing in application of paints and coatings of types specified with minimum five (5) years experience.
 - 2) Shall provide Owner and Architect a notarized certification that paint used is as specified.
 - b. Application:

- 1) Shall not proceed on surfaces which are not suitable to be painted, until such surfaces have been corrected. Notify Architect in writing of which surfaces need to be corrected and their locations. Surfaces shall be corrected by the responsible trades. Surfaces not suitable for painting shall include, but not be limited to:
 - (a) Damaged surfaces.
 - (b) Oily, greasy, dusty or excessively soiled surfaces.
 - (c) Non-dressed welds which will be exposed to view.
 - (d) Lack of touch-up where specified.
 - (e) Rusted or excessively deteriorated shop-prime painted surfaces.
- 2) Number of coats of each of several finishes shall be in accordance with detailed specifications, which will produce first quality finish if properly applied. If number of coats specified fails to produce a finish acceptable to Architect, this Contractor shall apply additional coat or coats at his own expense until acceptable finish is achieved

1.07 PRODUCT HANDLING

- A. Store only approved materials at the jobsite, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
- B. Temperature in the storage area shall be between 40 degrees F and 110 degrees F. Open and mix all materials in the storage area.
- C. Use all means necessary to protect materials before, during, and after application and to protect the installed work and materials of all other trades.
- D. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
- E. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 F, unless otherwise permitted by paint manufacturer's printed instructions.
- F. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.08 EXTRA STOCK

- A. Upon completion of the work of this section, deliver to the Owner, an extra stock equaling ten (10) percent or a minimum of one (1) gallon, whichever is greater, of each color, type, and gloss of paint used in the work, tightly sealing each container and clearly labeling contents and location where used.

1.09 WARRANTY

- A. The undertaking of a painting subcontract will indicate that the subcontractor will warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 1. Discoloring noticeably by yellowing, streaking, blooming, changing color or darkening
 2. Mildewing
 3. Peeling, cracking, blistering, alligatoring or releasing from the substrate
 4. Chalking or dusting excessively
 5. Changing sheen in irregular fashion
 6. Softening or becoming tacky
 7. Bubbling

- C. In the event of damage, immediately make all repairs and replacements necessary for approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.
- B. Paint materials listed herein, unless otherwise designated in the "Painting Schedule", are the products of The Sherwin-Williams Company, 101 Prospect Avenue N.W., Cleveland, OH 44115, (800) 321-8194 and require no further approval as to manufacturer or catalogue number.
- C. Similar firstline material of the following manufacturers may be used subject to approval by the Architect for items indicated to be coated:
 1. Paints:
 - a. The Sherwin-Williams Co.

2.02 MATERIALS

- A. Paint and Coatings: Ready mixed, except for field catalyzed coatings; having good flow and brushing properties and consistent drying or curing behavior, free of sags and streaks.
- B. Accessory Materials: Linseed oil, turpentine, paint thinners and other materials recommended by paint and coatings manufacturer as necessary to achieve finishes specified.
- C. Patching and Surface Preparation: Latex fillers as recommended by paint and coatings manufacturer.

2.03 COLORS

- A. Colors shall be as selected by Architect. Different colors may be selected for each room, and more than one (1) color may be selected in each room.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that site environmental conditions are appropriate and substrates are in proper condition to receive Work of this Section.
- B. Verify that shop applied primers are compatible with specified finish coats.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not begin application of coatings unless moisture content of surfaces is below the following maximum values:
 1. Gypsum soffits: 12 percent.
 2. Plaster: 12 percent.
 3. Masonry surfaces: 12 percent.
 4. Wood surfaces: 15 percent.
 5. Vertical concrete surfaces: 12 percent.
 6. Horizontal concrete surfaces: 8 percent.

3.02 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
 1. All ferrous metal
 2. All exterior galvanized metal
 3. All exterior wood
 4. All interior wood
 5. All prime coated hardware

6. All exposed conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 7. All exposed pipe, plumbing, and ductwork, including those located in mechanical rooms.
 8. All metal grilles, except aluminum, unless otherwise indicated.
 9. All exposed gypsum board surfaces, including all mechanical rooms.
 10. All exposed concrete masonry units (CMU), including all mechanical rooms.
 11. Miscellaneous other items which normally require painting or are scheduled to be painted.
 12. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 13. All exposed mechanical equipment and electrical equipment.
 14. Mechanical Room piping whether insulated or not insulated.
 15. All spray applied fireproofing in Mechanical Rooms.
 16. All cementitious wood fiber decks and exposed structure scheduled or noted to receive paint. Protect exposed wood structure from overspray.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.03 PREPARATION

- A. General: Surface must be clean to insure adhesion. Remove oil and grease with paint thinner. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding.
- B. Wall surfaces must be dry before painting. Verify with moisture meter.
- C. Unfinished Surfaces
 1. Wood: Sand smooth and apply one (1) coat of Primer Undercoat. After primer has dried overnight, putty nail holes and cracks, then spot-prime putty with primer. Again, allow the primer to dry over-night, sand lightly and topcoat.
 2. Masonry and Concrete: Remove efflorescence or cement dust on masonry and concrete by etching with a 10 percent solution or muriatic (Hydrochloric) acid. Flush off surface after etching with clean water, and paint while still damp. On surface where muriatic acid cannot be used to neutralize the efflorescence, remove the efflorescence by sanding, scraping or wire brushing and apply a coat of Masonry Conditioner before painting. If efflorescence is not present, no primer is necessary on concrete and masonry surfaces. Fill voids and pores in concrete and haydite blocks with Latex Block Filler and allow to dry overnight before topcoating.
 3. Iron and Steel: Prime with Metal Primer and allow to dry overnight before topcoating.
 4. Galvanized Metal: Prime with galvanized metal primer and allow to dry overnight before topcoating.

3.04 APPLICATION

- A. General: Surfaces to be finished must be clean, dry and free of dirt, oils, loose paint or any other contamination that would adversely affect adhesion, protective properties or appearance of the coating.
- B. Paint Thickness: Provide the following minimum dry film thickness per coat unless noted otherwise:
 1. Enamels on Metal: 1 mil
 2. Latex Paints: 1 mil
 3. Metal Primers: 1.5 mils
 4. Undercoats: 1.5 mils
 5. Oil Paints: 1.5 mils

6. Epoxy Coating: 2.0 mils
7. Thickness test: Use observation gauge that measures "V" shape scratch.
- C. Allow exterior paints to dry 72 hours between coats and interior paint to dry 24 hours between coats. Allow all enamels and varnishes to dry 24 hours between coats. If enamel and varnishes are tacky after 24 hours, allow additional time until finish is dry.
- D. Leveling: Apply with proper consistency and quality so paint flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread evenly.
- E. Appearance: Uniform color, texture and sheen.
- F. Neatness: Paint shall not be smeared, spattered or run over adjoining colors or materials. Cut-on lines shall be straight.
- G. First coat shall be white, unless otherwise specified.

3.05 CLEANING AND PROTECTION

- A. Keep project premises free of painting-related debris. Collect material that may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Protect work adjacent to painting operations from paint spatters and spills. Immediately remove paint that falls on finished surfaces not scheduled to receive paint, using materials and techniques that will not damage affected surfaces.

3.06 SCHEDULE

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when
- C. bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
 1. Galvanized Metal:
 - a. Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - c. Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)
 2. Un-galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - b. Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)
 3. Concrete and CMU:
 - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat
 4. Wood (Includes plywood siding and wooden trim):
 - a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41)
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.)
 5. Fiber-Cement Materials:
 - a. Primer: One (1) coat Loxon Masonry Primer (A24W300)
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series)
 6. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
 7. All piping in mechanical rooms shall be painted in their entirety, in the following colors:
 - a. Orange
 - b. White
 - c. Pink
 - d. Red

- e. Green
 - f. Blue
- D. Interior Surfaces:
- 1. Galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - b. Finish: Two (2) coats Pro Industrial 0 VOC Acrylic Semi-Gloss
 - 2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 - a. Shop coat by others.
 - b. One (1) coat over Steel Kem Kromik Primer B50series.
 - c. One (1) coat over Aluminum Metal Procryl Primer B60series
 - d. Two (2) coats PM200 Alkyd Semi Gloss B34series
 - 3. Gypsum Wallboard:
 - a. Primer: One (1) coat ProGreen 200 Latex Primer (B28W600)
 - b. Finish: Two (2) coats ProGreen 200 Latex Egg-Shell (B20W200 Series)
 - 4. Concrete and CMU: (Enamel)
 - a. Primer: One (1) coat ProMar Block Filler (AB25W25)
 - b. Finish: Two (2) coats ProGreen 200 Latex Semi-Gloss (B31-600 Series)
 - 5. Wood: (Painted)
 - a. Primer: ProMar Classic Latex Primer (B28W101)
 - b. Finish: ProClassic Waterborne Semi-Gloss (B31 Series)
 - 6. Wood: (Stained)
 - a. Stain: SherWood BAC Wiping Stain (S64 Series)
 - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series)
 - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series)
 - 7. Gypsum Wallboard: (Epoxy) – Kitchens, bathrooms, laboratories, etc.
 - a. Primer: One (1) coat ProMar 200 Latex Primer (B28W200)
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60)
 - 8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
 - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46)
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60)
 - 9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
 - a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
 - b. Finish: Two (2) coats bright aluminum paint.

END OF SECTION

SECTION 09 9113 EXTERIOR PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes surface preparation and the application of paint systems on:
 1. Concrete.
 2. Fiber-cement board.
 3. Clay masonry.
 4. Concrete masonry units (CMU).
 5. Steel.
 6. Galvanized metal.
 7. Aluminum (not anodized or otherwise coated).
 8. Stainless-steel flashing.
 9. Plastic trim fabrications.
 10. Exterior portland cement plaster (stucco).
 11. Exterior gypsum board.
- B. Related Requirements:
 1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this section.
 2. Section 09 9123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 3. Section 09 9300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.
 4. Section 09 9600 "High-Performance Coatings" for tile-like coatings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 2. Label each coat of each Sample.
 3. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Indicate VOC content.

1.04 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location 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.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: [1 gal. (3.8 L)] of each material and color applied.

1.06 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 1. Product name and type (description).
 2. Batch date.
 3. Color number.
 4. VOC content.
 5. Environmental handling requirements.
 6. Surface preparation requirements.
 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- D. Hazardous Materials: Hazardous materials including lead paint [are] [may be] present in buildings and structures to be painted. A report on the presence of known hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified.
 2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products as indicated or comparable products
- B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:
 1. Products are approved by manufacturer in writing for application specified.
 2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.
- C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: For field applications, provide paints and coatings that complies with VOC content limits of authorities having jurisdiction.
- C. Colors: [As selected by Architect from manufacturer's full range] [Match Architect's samples] [As indicated in a color schedule].
 1. [10] [20] [30] percent of surface area will be painted with deep tones.

2.03 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Fiber-Cement Board: 12 percent.

- c. Masonry (Clay and CMU): 12 percent.
- d. Wood: 15 percent.
- e. Portland Cement Plaster: 12 percent.
- f. Gypsum Board: 12 percent.
- 2. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- 3. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 3. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Paint entire exposed surface of window frames and sashes.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Mechanical ductwork and fittings where exposed, unless otherwise noted.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE

- A. Concrete, Clay Masonry, Stucco, and Cementitious Siding, Nontraffic Surfaces:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex.
 - 1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - b. Prime Coat: Latex, exterior, matching topcoat.
 - c. Intermediate Coat: Latex, exterior, matching topcoat.
 - d. Topcoat: Latex, exterior, flat.
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, low sheen.
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, satin.
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - g. Topcoat: Latex, exterior, semi-gloss.
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - h. Topcoat: Latex, exterior, gloss.
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.
 - 2. Latex over Latex Aggregate System:
 - a. Prime Coat: Block Filler, Latex, Interior/Exterior.
 - 1) S-W Loxon Block Surfacer, A24W200, at 50 to 100 sq. ft. per gal. (1.23 to 2.45 sq. m per liter).
 - b. Topcoat: Latex, exterior flat, medium texture.
 - 1) S-W UltraCrete Textured Masonry Topcoat, A44-800 Series, 50 to 80 sq. ft. per gal. (1.23 to 1.96 sq. m per liter).
 - 3. Concrete Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish matching topcoat.
 - b. Topcoat: Low-luster opaque finish:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal. (1.23 to 6.14 sq. m per liter).
- B. Concrete Substrates, Pedestrian Traffic Surfaces:
 - 1. Latex Floor Paint System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss.
 - 1) S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
 - 2. Concrete Stain System (Water-based) for Vertical Surfaces:
 - a. First Coat: Low-luster opaque finish matching top coat.
 - b. Topcoat: Low-luster opaque finish.
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal. (1.23 to 6.14 sq. m per liter).
- C. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior:
 - 1) S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).
 - b. Intermediate Coat: Latex, exterior, matching topcoat.

- c. Topcoat: Latex, exterior, flat.
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - d. Topcoat: Latex, exterior, low sheen.
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, satin.
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss.
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - g. Topcoat: Latex, exterior, gloss.
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.
2. CMU Stain System (Water-Based):
- a. First Coat: Low-luster opaque finish matching topcoat.
 - b. Topcoat: Low-luster opaque finish.
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal. (1.23 to 6.14 sq. m per liter).
- D. Ferrous Metal, Galvanized-Metal, and Aluminum Substrates:
- 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, water based.
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based eggshell.
 - 1) S-W Pro Industrial Eg-Shel Acrylic B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss.
 - 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - e. Topcoat: Light industrial coating, exterior, water based, gloss.
 - 1) S-W Pro Industrial Acrylic Gloss Coating, B66-600 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
- E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
- 1. Latex System:
 - a. Prime Coat: Primer, latex for exterior wood.
 - 1) S-W Exterior Latex Primer, B42, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat:
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - d. Topcoat: Latex, exterior, low-sheen:
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, satin:
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss:
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

- g. Topcoat: Latex, exterior, gloss:
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.

F. Wood Substrates, Pedestrian Traffic Surfaces:

- 1. Latex Floor Paint System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss:
 - 1) S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
- 2. Solid Color Stain System:
 - a. First Coat: Solid color stain, latex, matching topcoat.
 - b. Topcoat: Solid color stain, latex, slip-resistant, flat, interior/exterior:
 - 1) S-W SuperDeck Exterior Acrylic Solid Color Deck, SD7-Series, at 200 to 400 sq. ft. per gal. (4.91 to 37.16 sq. m per liter).

G. Plastic Trim Fabrication Substrates: Including architectural PVC, plastic, and fiberglass items.

- 1. Latex System:
 - a. Prime Coat: Primer, bonding, water-based:
 - 1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat:
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - d. Topcoat: Latex, exterior, low-sheen:
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, satin:
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss:
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - g. Topcoat: Latex, exterior, gloss:
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.

H. Exterior Gypsum Board Substrates:

- 1. Latex System:
 - a. Prime Coat: Primer bonding, water-based:
 - 1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat:
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - d. Topcoat: Latex, exterior, low-sheen:
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, satin:
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, semi-gloss:
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.

- g. Topcoat: Latex, exterior, gloss.
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.
- I. Exterior Insulation Finish System (EIFS) and Vinyl Siding:
 - 1. Latex System:
 - a. First Coat: Latex, exterior, matching topcoat.
 - b. Topcoat: Latex, exterior flat.
 - 1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils (0.102 mm) wet, 1.2 mils (0.030 mm) dry, per coat.
 - c. Topcoat: Latex, exterior, low-sheen:
 - 1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Latex, exterior, satin:
 - 1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - e. Topcoat: Latex, exterior, semi-gloss:
 - 1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - f. Topcoat: Latex, exterior, gloss:
 - 1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils (0.102 mm) wet, 1.3 mils (0.033 mm) dry, per coat.

END OF SECTION

**SECTION 09 9123
INTERIOR PAINTING**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 1. Clay masonry.
 2. Galvanized metal.
 3. Aluminum (not anodized or otherwise coated).
 4. Gypsum board.
 5. Plaster.
 6. Spray-textured ceilings.
 7. Cotton or canvas insulation covering.
 8. ASJ insulation covering.
- B. Related Requirements:
 1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this section.
 2. Section 09 9113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 3. Section 09 9300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
 4. Section 09 9600 "High-Performance Coatings" for tile-like coatings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 1. Indicate VOC content.
- B. Sustainable Design Submittals:
 1. Product Data for LEED 2009 Credit EQ 4.2: For paints and coatings, showing printed statement of VOC content.
 2. Laboratory Test Reports: For paints and coatings, indicating compliance with LEED 2009 Credit EQ 4.2 requirements for low-emitting materials.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 2. Label each coat of each Sample.
 3. Label each Sample for location and application area.
- E. Product List: For each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Indicate VOC content.

1.04 CLOSEOUT SUBMITTALS

1. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location 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.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 1 gal. (3.8 L) of each material and color applied.

1.06 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
 - 1. Product name and type (description).
 - 2. Batch date.
 - 3. Color number.
 - 4. VOC content.
 - 5. Environmental handling requirements.
 - 6. Surface preparation requirements.
 - 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Lead Paint: It is not expected that lead paint will be encountered in the Work.
 - 1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.
- D. Lead Paint: Lead paint [is] [may be] present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.
 - 1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.

2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products as indicated or comparable products.
- B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 01 6000 "Product Requirements," and the following:
 1. Products are approved by manufacturer in writing for application specified.
 2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.
- C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall provide materials that comply with VOC limits of authorities having jurisdiction and for interior paints and coatings applied at Project site, the following VOC limits exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Primers, Sealers, and Undercoaters: 200 g/L.
 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 5. Floor Coatings: 100 g/L.
 6. Shellacs, Clear: 730 g/L.
 7. Shellacs, Pigmented: 550 g/L.
- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers."
- D. Colors: As indicated in the Project Drawings and Schedules.

2.03 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected

materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
 1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
- B. Substrate Conditions:
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - e. Plaster: 12 percent.
 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 3. Plaster Substrates: Verify that plaster is fully cured.
 4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.

- c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 INTERIOR MICROBICIDAL PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - b. First Coat: Microbicidal Latex, interior, matching topcoat.
 - c. Topcoat: Microbicidal Latex, interior, eggshell:
 - 1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry, per coat. Brush and roll application only.
- B. CMU Substrates:
 1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.
 - a. Block Filler: Two coats as required: Block filler, latex, interior/exterior:
 - 1) S W Loxon Block Surfacer, A24W200, at 10.0 mils (0.254 mm) wet, 8.0 mils (0.203 mm) dry, per coat.
 - b. First Coat: Microbicidal Latex, interior, matching topcoat.
 - c. Topcoat: Microbicidal Latex, interior, eggshell:
 - 1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat. Brush and roll application only.
- C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
 1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

- a. Prime Coat: Primer, latex, interior, anti-microbial:
 - 1) S-W PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry.
 - b. First Coat: Microbicidal Latex, interior, matching topcoat.
 - c. Topcoat: Microbicidal Latex, interior, eggshell:
 - 1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry, per coat. Brush and roll application only.
- D. Gypsum Board, Plaster, and Spray-Texture Ceiling Substrates:
- 1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - b. First Coat: Microbicidal Latex, interior, matching topcoat.
 - c. Topcoat: Microbicidal Latex, interior, eggshell:
 - 1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry, per coat. Brush and roll application only.

3.07 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Latex System:
 - a. Prime Coat: Primer, latex, interior.
 - 1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat.
 - 1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - d. Topcoat: Latex, interior, low sheen.
 - 1) S-W ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - e. Topcoat: Latex, interior, eggshell.
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat .
 - f. Topcoat: Latex, interior, semi-gloss.
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat .
 - g. Topcoat: Latex, interior, gloss.
 - 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - 2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
 - 4. Concrete Stain System (Water-based) for Vertical Surfaces:

- a. First Coat:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
 - b. Second Coat:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
- B. Concrete Substrates, Pedestrian Traffic Surfaces:
- 1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
 - 2. Clear Acrylic System, Gloss Finish:
 - a. First Coat:
 - 1) S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer, at 100 to 200 sq. ft. per gal. (2.45 to 4.91 sq. m per liter).
 - b. Second Coat:
 - 1) S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer, at 100 to 200 sq. ft. per gal. (2.45 to 4.91 sq. m per liter).
 - 3. Concrete Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
 - b. Second Coat: Low-luster opaque finish:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
 - 4. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
 - 5. Epoxy- and Urethane- Based Aggregate-Filled Floor Surfacing: Refer to Section 09 67 23 "Resinous Flooring."
- C. CMU Substrates:
- 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior:
 - 1) S-W PrepRite Block Filler, B25W25, at 75-125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat:
 - 1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - d. Topcoat: Latex, interior, low sheen:
 - 1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - e. Topcoat: Latex, interior, eggshell:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - g. Topcoat: Latex, interior, gloss:
 - 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 2. Water-Based Light Industrial Coating System:
 - a. Block Filler: Block filler, latex, interior/exterior:
 - 1) S-W PrepRite Block Filler, B25W25, at 75-125 sq. ft. per gal. (1.84 to 3.07 sq. m per liter).

- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 3. Concrete Stain System (Water-based):
 - a. First Coat:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
 - b. Second Coat:
 - 1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal. (1.23 to 7.36 sq. m per liter).
 - 4. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
 - 5. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
- D. Metal Substrates (Aluminum, Steel, Galvanized Steel):
- 1. Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic, semi-gloss:
 - 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - d. Topcoat: Water-based acrylic, gloss:
 - 1) S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - 2. Water-Based Dry-Fall System:
 - a. Top Coat: Dry-fall latex, flat:
 - 1) S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils (0.152 mm) wet, 1.5 mils (0.038 mm) dry.
 - b. Top Coat: Dry-fall latex, eggshell:
 - 1) S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils (0.152 mm) wet, 1.9 mils (0.048 mm) dry.
 - c. Top Coat: Dry-fall latex, semi-gloss:
 - 1) S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
 - 3. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based:
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
 - 5. Waterbased/Akyd Urethane System:

- a. Prime Coat:
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - c. Topcoat: Water-based alkyd-urethane, semi-gloss, interior:
 - 1) S-W Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - d. Topcoat: Water-based alkyd-urethane, gloss, interior:
 - 1) S-W Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
- E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
- 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, eggshell:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - d. Topcoat: Latex, interior, semi-gloss:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - e. Topcoat: Latex, interior, gloss:
 - 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 2. Waterbased/Akyd Urethane System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry.
 - b. Intermediate Coat: Water-based alkyd-urethane, interior, matching topcoat.
 - c. Topcoat: Water-based alkyd-urethane, semi-gloss, interior:
 - 1) S-W Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - d. Topcoat: Water-based alkyd-urethane, gloss, interior:
 - 1) S-W Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - 3. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- F. Wood Substrates, Pedestrian Traffic Surfaces:
- 1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss:

- 1) S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.

G. Gypsum Board, Plaster, and Spray-Texture Ceiling Substrates:

1. Latex System:
 - a. Prime Coat: Primer, latex, interior:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat:
 - 1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - d. Topcoat: Latex, interior, low sheen:
 - 1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - e. Topcoat: Latex, interior, eggshell:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - g. Topcoat: Latex, interior, gloss:
 - 1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss:
 - 1) S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

END OF SECTION

SECTION 10 0100
MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. TV Mounting Brackets
- B. Rapid Entry System (Fireman's Lock Box)

1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-in-Place Concrete
- B. Section 04 2000 - Unit Masonry
- C. Section 05 5000 - Miscellaneous Metals: Metal bracing, fasteners and other support components
- D. Section 06 1000 - Rough Carpentry: Wood blocking
- E. Section 09 2116 - Gypsum Board Assemblies
- F. Section 09 5100 - Acoustical Ceilings
- G. Division 26 – Electrical

1.03 SUBMITTALS

- A. Product Data:
 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's installation instructions.
 3. Manufacturer's operation and maintenance data, as applicable.
- B. Shop Drawings: Show sizes, locations and installation details. Include utility (electrical, water, gas) requirements.
- C. Samples: Color charts showing manufacturer's full range of colors.

1.04 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 3113 – Project Coordination.

1.05 COORDINATION

- A. Coordinate Work of this Section with work of other sections in which items are to be installed.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Specifications are based on named products and manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.02 MATERIALS

- A. LCD Monitor Mounting Brackets:
 1. Wall Mounted Brackets for mounting on wood studs or masonry wall:
 - a. Features:
 - 1) Universal adapter plate included
 - 2) Pull-out swivel with up to 45° rotation depending on screen size
 - 3) Locking tab provides optional swivel restriction to one side
 - 4) " deep in closed position, up to 11.9" fully extended
 - 5) 0°, 5° or 10° lockable incremental tilt
 - 6) +/-1° roll for horizontal screen alignment during installation
 - 7) Built-in cord management

- 8) Lock KeyTM installation tool secures arms for screen installation
 - 9) Lock-out screw prevents unwanted extension
 - 10) Mounts to wood blocking, concrete, cinder block
 - 11) Includes mounting and screen attachment hardware
 - b. Size: Capable of securely holding a 32-75 inch television, as required, and furnished by Owner.
 - c. Color: Black
 - d. Number/Location: As shown on drawings.
 - e. Approved Product/Manufacturer: Model No. SP850-UNLP-GB as manufactured by Peerless Industries, Inc., Melrose Park, IL; (708) 865-887 or equivalent manufactured by Bretford Manufacturing, Inc., Schiller Park, IL; (800) 521-9614; Lucasey Mfg. Corp., Oakland, CA: (800) 582-2739; Chief Brand of Milestone AV Technologies, Eden Prairie, MN; (800) 582- 6480; or Architect approved equal.
2. Ceiling Mounted Brackets:
 - a. Features:
 - 1) 0° to 20° adjustable tilt and 360° swivel
 - 2) Screen mounts vertically or horizontally
 - 3) Uses standard 1 1/2" – 11.5 NPT schedule 40 pipe
 - 4) Additional length can be added for lowering
 - 5) Theft-resistant security fasteners secure the screen to the mount
 - 6) Sold with or without ceiling plate
 - 7) Cord management
 - 8) Complete detailed installation instructions for wood and
 - 9) concrete structures
 - b. Size: Capable of securely holding a 32-71 inch television, as required, and furnished by Owner.
 - c. Color: Black
 - d. Number/Location: As shown on drawings.
 - e. Approved Product/Manufacturer: Model No. PLCM-UNL as manufactured by Peerless Industries, Inc., Melrose Park, IL; (708) 865-887; or equivalent manufactured by Bretford Manufacturing, Inc., Schiller Park, IL; (800) 521- 9614; Lucasey Mfg. Corp., Oakland, CA: (800) 582-2739; Chief Brand of Milestone AV Technologies, Eden Prairie, MN; (800) 582-6480; or Architect approved equal.
 - B. Motorized Projection Screens:
 1. Type: Electrically operated 120 volt (60 Hz), 3.1 amp, with three (3) wire with a quick connect male plug-in connector on the motor. Motor shall be mounted inside the roller, to be three wire with ground, quick reversal type, oiled for life, with automatic thermal overload cutout, integral gears, capacitor and an electric brake to prevent coasting. To have preset but accessible limit switches to automatically stop picture surface in the "up" and "down" positions. Screen manufacturer shall furnish electrical operator switch for installation under Division 16.
 2. Roller: To be of rigid metal, at least 5.75 inches in diameter and mounted on two
 3. (2) heavy duty brackets equipped with self-aligning bearings.
 4. Screen Fabric: To be flame retardant and mildew resistant, Matt White picture surface with black masking borders.
 5. Case: Top, front and back of case to be made of extruded aluminum powder coated white. End caps to be of heavy gauge steel, powder coated white. Bottom of case to have a removable access door. Door to be of extruded aluminum powder coated white. Bottom of case to be self-trimming, with a built-in flange around the bottom of the case.
 6. Controls: To be complete with three (3) position control switch in box with cover plate located as shown on drawings or required.
 7. Listing and Approvals: Screen to be listed by Underwriters' Laboratories (UL) and CSA.
 8. Screen: Matte-White surface and black borders. Provide additional screen drop material as required for finished screen to extend three (3) feet AFF.

9. Horizontal Seams: Seamless.
 10. Number/ Size, Location: Provide one 240" wide x 138" high with black Extra Drop to lower picture area below top of proscenium opening, approximately 15'-1" at auditorium. Provide one 192" wide x 111" high at Commons.
 11. Mounting: Recessed above ceiling, unless shown otherwise, in location shown on drawings.
 12. Approved Product/Manufacturer: "Rolleramic" manufactured by Draper, Spiceland, IN (765) 987-7999, Bretford Manufacturing, Inc. or equal by Da-Lite Screen Company, Inc., Warsaw, IN (800) 622-3737; (800) 521-9614, or Architect approved equal.
- C. Rapid Entry System (Fireman's Lock Box)
1. Fire Department Lock Box (main entry): Knox Company No.3200 recessed, with recessed mounting kit.
- D. LCD Projector Mounts:
1. Type: Mounts are designed to be flush mounted to a structural or finished ceiling or can be drop mounted with the addition of an extension column and ceiling attachment plate. The projector mounts are suitable for most LCD projectors weighing up to 50 lbs., they feature a four way adjustable rubber-lined clamp design that surrounds and securely holds the projector without scratching it. The mount features 10 degree pitch and 360 degree yaw when used with an extension column.
 2. Specifications:
 - a. 20 degrees (+5 degrees, -15 degrees) pitch, 10 degrees (± 5 degrees) roll, 360 degrees yaw.
 - b. Two-piece interchangeable design.
 - c. Quick release spring latch with security lock.
 - d. Extension column compatible.
 - e. Sturdy all-steel construction.
 - f. Black fused epoxy finish.
 - g. Security hardware.
 - h. UL Listed.
 3. Accessories:
 - a. Fixed or adjustable extension columns as shown.
 - b. Fasteners and anchors as required for secure installation.
 4. Location: As shown on drawings or in location determined by Architect.
 5. Approved Product/Manufacturer: Model No. PRG-UNV Universal LCD Projector Mount as manufactured by Peerless Industries, Inc., Melrose park, IL; (800) 865- 2112; Chief Brand of Milestone AV Technologies, Eden Prairie, MN; (800) 582- 6480; or Architect approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify utility (electrical, water, and gas) requirements, where applicable, are installed and ready for connection.
- B. Verify items fastened to walls have proper blocking or support items installed.
- C. Verify locations for items are ready for their installation.

3.02 INSTALLATION

- A. Install all items in accordance with manufacturer's printed instructions in locations shown on drawings.
 - (a)
- B. Fasten TV brackets securely to walls where indicated on drawings.
- C. Install projection screen housing in conjunction with installation of ceiling system. After interior construction is essentially complete, install viewing surface and operating mechanism in

housing. Install screens securely to supporting substrate so that screens are level and back of case is plumb. Provide required brackets, hanger rods, and fasteners.

3.03 CLEANING AND ADJUSTING

- A. Make final adjustment after installation and clean all backstop support piping of dirt and other substances which may affect final finish.
- B. Clean all items of dirt and foreign matter which may affect appearance and operation.
- C. Adjust items for proper operation.
- D. Instruct Owner's personnel on proper operation and maintenance of items.

END OF SECTION

SECTION 10 1400 GRAPHICS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide the following:
 - 1. Exterior wall mounted Building Address
 - 2. Traffic signage, including, but not limited to accessibility (Handicapped) parking signs.
 - 3. Brackets, clips, posts, fasteners, concrete footings, and all accessories required for proper installation of signage.

1.02 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicating materials, sizes, and finishes, details of fabrication and installation, fasteners and hardware, attachments, related and adjacent work.
 - 2. Rubbing of actual pattern of cast metal plaque for Architect's approval prior to casting.
- C. Samples:
 - 1. One (1) 4 inch actual sample of cast metal letter in specified letter style and finish.
 - 2. One (1) actual sample of each type room identification sign with specified finish.

1.03 QUALITY ASSURANCE

- A. Americans with Disabilities Act (ADA)
- B. Texas Accessibility Standards (TAS)

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products and manufacturers listed as basis of specification or named. Products of manufacturers listed which meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.02 MATERIALS

- A. Cast Metal Dedication Plaque: Aluminum
 - 1. Material and Fabrication:
 - a. Casting: Shall be of virgin ingots of F-214 Aluminum Alloy and shall be free of pits and gas holes and all letters shall be sharp and hand tooled.
 - b. Border Style: Single line standard border design.
 - c. Letter Style/Sizes: Shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise. Letter sizes shall be as shown on drawings.
 - d. Finishes:
 - 1) Borders and Letter Faces: satin finish.
 - 2) Background: leatherette texture sprayed with Gun Metal Gray acrylic lacquer.
 - 3) Plaque shall be chemically cleaned and etched and treated with alodine.
 - 4) Completed plaque shall be sprayed with two (2) coats of clear acrylic lacquer.
 - 2. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of plaque on brick wall where indicated on drawings.
 - 3. Provide all materials required for a complete installation.
 - 4. Approved Manufacturers:

- a. R.K. Ramos Architectural Signage Systems, Oklahoma City, OK; (405) 235-5505
 - b. Benchmark Signs, Benbrook, TX; (817) 560-9965
 - c. Best Manufacturing Sign Systems, Montrose, CO; (800) 235-2378
 - d. York Bronze Company, Bryan, TX; (800) 488-4662
 - e. Gemini Incorporated, Cannon Falls, MN; (800) 538-8377
 - f. Matthews Bronze, Pittsburgh, PA; (800) 950-1317
 - g. Metal Arts, Division of L & H Mfg. Co., Mandan, ND; (800) 237-8069
 - h. ProWorx Architectural Signage, Houston, Texas; (713) 666-3131
 - i. The Southwell Co., San Antonio, TX; (210) 223-1831 (Basis of Specification)
- B. Cast Metal Letters:
- 1. Material and Fabrication:
 - a. Casting shall be of 319 aluminum alloy with satin polished faces and matte sides.
 - b. Letters shall be finished in clear anodized finish.
 - c. Letters shall be 12 inch high in Helvetica Medium upper case letters, unless shown otherwise.
 - 2. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of letters on brick wall where indicated on drawings.
 - 3. Provide all materials required for a complete installation.
 - 4. Approved Manufacturers:
 - a. R.K. Ramos Architectural Signage Systems, Oklahoma City, OK; (405) 235-5505
 - b. Benchmark Signs, Benbrook, TX; (817) 560-9965
 - c. Best Manufacturing Sign Systems, Montrose, CO; (800) 235-2378
 - d. York Bronze Company, Bryan, TX; (800) 488-4662
 - e. Gemini Incorporated, Cannon Falls, MN; (800) 538-8377
 - f. Matthews Bronze, Pittsburgh, PA; (800) 950-1317
 - g. Metal Arts, Division of L & H Mfg. Co., Mandan, ND; (800) 237-8069
 - h. ProWorx Architectural Signage, Houston, Texas; (713) 666-3131
 - i. The Southwell Co., San Antonio, TX; (210) 223-1831 (Basis of Specification)
- C. Room Identification Signage:
- 1. General:
 - a. Constructed of one (1) or two (2) high pressure laminate in colors selected by Architect, laminated to a 1/8 inch thick acrylic back.
 - b. Signage shall have radius or square corners with square-cut edges painted a color as selected by Architect.
 - c. Demarcation line, if any, shall be infilled to match copy color.
 - d. Signs shall comply with all state and federal codes, including, but not limited to the ADA and TAS requirements.
 - e. Refer to drawings for signage details for dimensions, types, colors, graphic layout, and mounting and height specifications.
 - 2. Room Numbers, Symbols, and Restroom Copy:
 - a. Matte finished acrylic, raised 1/32 inch, of color contrasting to the face laminate.
 - b. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion.
 - c. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Durodots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
 - 3. Lower or Secondary Copy:
 - a. Minimum of 5/8 inch high incised sans serif style, (Helvetica, Optima, Futura as selected by Architect), all caps, paint-filled in a color as selected by Architect.
 - 4. Restroom Pictograms:
 - a. Shall appear on a minimum six (6) inch square, unobstructed field.

5. Window (Slotted) Signs:
 - a. Open on both ends for an insert by Owner, window shall be a non-glare acrylic window, with an exposed color laminate behind in color as selected by Architect.
 6. Fasteners and Accessories:
 - a. 1/8 inch thick, double-sided foam tape of type recommended to suit application and commercial grade silicone sealant.
 - b. Back-up plates shall be supplied, where shown or required, for signage mounted on glass.
 7. Provide all materials required for a complete installation.
 8. Approved Manufacturers:
 - a. Signage:
 - 1) South Texas Graphic Specialties, Inc., Houston, TX; (713) 467- 4499 (Basis of Specification)
 - 2) Benchmark Signs, Benbrook, TX; (817) 560-9965
 - 3) ProWorx Architectural Signage, Houston, Texas; (713) 666-3131
 - 4) Stanley Signature Signs, Katy, TX; (281) 395-6106
 - 5) Motivational Systems, Inc. San Antonio, TX; (210) 805-9555
 - b. Plastic Laminate:
 - 1) Formica Corp.
 - 2) Wilsonart International
- D. Traffic Signs:
1. Signage Materials: 0.080 inch thick aluminum or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border. Signs shall have 1-1/2 inch radius at corners typically. Sizes shall be as shown on drawings or required by authorities having jurisdiction.
 2. Post Materials: Provided by Section 05 50 00, Miscellaneous Metals.
 3. Graphics:
 - a. Accessibility ("Handicapped Parking") signs with lettering and graphics as detailed. All work shall comply with local codes, ADA, and TAS standards and requirements.
 - b. "Stop", "No Parking" and "One Way" signs with lettering and graphics as detailed. All work shall comply with local codes, and standards and requirements of authorities having jurisdiction.
 4. Accessories:
 - a. Sign Mounting Hardware: Provide sign mounting hardware of galvanized steel of type and size instructed by manufacturer to suit intended use.
 - b. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.
 - c. Provide all materials required for signage and proper installation.
- E. Post and Panel Sign for Site Directory / Directional Signage: To be determined by Architect at later date.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Cast Metal Dedication Plaque:
 1. Install in accordance with manufacturer's instructions.
 2. Install in location shown on drawings.
 3. Install with concealed fasteners of threaded bolt screwed into back of plaque and inserted into hole drilled in brick at an angle and filled with cement.
- B. Cast Metal Letters:
 1. Install in accordance with manufacturer's instructions.
 2. Install in location shown on drawings
 3. Install with concealed fasteners in flush mounting or projected mounting as shown on drawings.

- C. Room Identification Signs:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Install in locations shown on drawings.
 - 3. Install with double-sided foam tape and a bed of silicone sealant.
 - 4. Where shown or required, mount signs on glass using back-up plates.
- D. Traffic Signs:
 - 1. Install sign posts in concrete footings as shown on drawings, with signs set to heights as shown on drawings.
 - 2. Install signs on posts in accordance with manufacturer's instructions.
- E. Post and Panel Sign for Site Directory / Directional Signage:
 - 1. Install signposts in concrete footings as shown on drawings, with signs set to heights as shown on drawings.
 - 2. Install signs on posts in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 2113.19
SOLID POLYMER TOILET PARTITIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Solid polymer, floor mounted, overhead braced, toilet partitions fabricated of non- corrosive High Density Polyethylene (HDPE) materials with hardware, fasteners, and accessories.

1.02 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show all required field measurements, all details and elevations, plans and sections required to indicate all conditions, and dimensioned drawings of hardware.
- C. Samples:
1. Actual samples or color charts indicating manufacturer's full line of colors for Architect's selection and approval.
 2. Actual samples of each item of hardware.
- D. Certification: Manufacturer's written certification indicating compliance with building code authorities having jurisdiction regarding to the use of the material on the Project as it applies to the use of "plastic in a commercial building".

1.03 DELIVERY AND STORAGE

- A. Delivery: Deliver clearly labeled, undamaged materials in the manufacturer's special protective plastic covering.
- B. Timing and Coordination: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. Storage: Store materials in a clean, dry location, protected from weather and abuse.

1.04 WARRANTY

- A. Warrant the work specified herein for 15 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

PART 2 – PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Manufacturers listed who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 regarding substitution requirements to be considered.
1. Accurate Partitions Corp., Lyons, IL
 2. Ampco Products, Inc., Sanger, TX
 3. Santana Comtec / Scranton Products, Scranton, PA
 4. General Partitions Mfg. Corp., Erie, PA
 5. Global Steel Products Corp., Deer Park, NY
 6. Metpar Corp, Westbury, NY
 7. Columbia Partitions, a Division of PSiSC, Columbia, SC

2.02 TOILET PARTITIONS

- A. Materials:
1. All toilet partitions shall be floor mounted, overhead braced, with non-corrosive panels doors and pilasters of solid polymer and in the dimensions and arrangements indicated on the drawings. Partitions between urinals and lavatories shall have floor mounted pilasters.

2. Panels, doors and pilasters shall be fabricated from Polymer resins under high pressure forming a single component section which is waterproof, non-absorbent and has a self-lubricating surface that resists marking with pens, pencils or other writing utensils.
- B. Construction and Fabrication:
 1. Doors, Panels, and Pilasters: one (1) inch thick and all edges machined to a radius of 0.250 inch and all exposed edges to be free of saw marks.
 2. Dividing Panels: 55 inches high and shall be mounted at 14 inches above the finished floor.
 3. Doors: 55 inches high and shall be mounted at 14 inches above the finished floor.
 4. Pilasters: 82 inches high.
 5. Urinal Screens: 24 inches deep x 60 inches high and shall be mounted 12 inches above finished floor.
 6. Finish: Doors, panels, urinal screens, and pilasters shall be equal to "Plasti-Glaze 280" in color selected by Architect from manufacturer's colors.
 7. Edging Strips: aluminum fastened to the bottom edge of all doors and panels utilizing vandal-proof stainless steel fasteners.
 8. Door hardware shall be as follows:
 9. Pilaster Shoes: 3 inch high 20 gauge stainless steel shoes with theft proof sex bolts.
 10. Wall Brackets: full length continuous wall brackets (6463-T5 Alloy) with mill finish weighing not less than 1.685 lbs. per linear foot similar or equal to section #58992 shall be used for all panels to pilaster, pilaster to wall, and panel to wall connections. Predrill by manufacturer with holes spaced every six (6) inches
 11. along full length of brackets. Thru-bolt to panels and pilasters with one-way sex bolts.
 12. Headrail: fabricated from heavy aluminum extrusion (6463-T5 Alloy) with mill finish in anti-grip configuration weighing not less than 1.188 lbs. per linear foot similar or equal to section #58993. Fasten to tops of pilasters and headrail brackets by thru-bolting with one-way sex bolts.
 13. Headrail Brackets: 16 gauge stainless steel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

3.02 INSTALLATION

- A. Install partitions, compartments, and benches in substantial manner, straight, plumb, and true in accordance with manufacturer's instructions.
- B. Install all partitions, compartments, and benches where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for a long life under hard use and in complete accordance with the manufacturer's recommendations.
- C. Pilaster shoes shall be anchored to the floor with No. 5 plastic anchors and No. 14 stainless steel philips head screws.
- D. Attachment of brackets to adjacent wall construction shall be accomplished by one (1) theft proof Zamac mushroom nail in head anchor directly behind the vertical edge of panels and pilasters at every 12 inches along the length of bracket and two (2) No. 5 plastic anchors and No. 14 x 1-1/4 inch stainless steel philips head screws at each 12 inch interval alternately spaced between anchor connections.
- E. No evidence of drilling, cutting or patching shall be visible in the finished work. Defaced finish will not be permitted. Damaged, scratched or marred defective materials will be rejected and shall be replaced with new materials.

3.03 CLEANING AND ADJUSTING

- A. Clean surfaces free of dirt, oil, grease and other imperfections.

- B. Clearance of vertical edges of doors shall be uniform top to bottom and shall not exceed 3/16 inch.
- C. Except for toilet partitions for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

END OF SECTION

SECTION 10 2813 TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Toilet accessories; shower accessories; and utility room accessories.

1.02 RELATED SECTIONS

- A. Section 04 2000 - Masonry.
- B. Section 05 4000 - Cold Formed Metal Framing
- C. Section 09 2116 - Gypsum Board Assemblies
- D. Section 09 3013 - Ceramic Tile
- E. Section 10 2113.19 - Solid Polymer Toilet Partitions

1.03 OWNER FURNISHED CONTRACTOR INSTALLED ITEMS

- A. The Owner shall furnish the following items to the Contractor in a timely basis for installation into the work:
 - 1. Soap Dispensers (SD)
 - 2. Toilet Tissue Dispensers (TP)
 - 3. Paper Towel Dispenser (PT)
- B. Contractor shall furnish and install other items specified or shown on drawings.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and technical data.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance instructions of units specified.
 - 4. Provide schedule of materials and installation locations.
- B. Shop drawings: Indicate size, material and finish. Show locations, installation procedures. Include details of joints, attachments, fasteners, clearances, and mounting heights.

1.05 MINIMUM COMPLIANCE STANDARDS

- A. Comply with ANSI A117.1 and Texas Accessibility Standards (TAS) and with referenced standards specified with each product or material.

1.06 QUALITY STANDARDS

- A. Design, finish and keying of items shall be the same.
- B. Furnish items from one (1) manufacturer only unless otherwise specified or directed by Architect.

1.07 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 3113 – Project Coordination

1.08 COORDINATION

- A. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.09 WARRANTY

- A. Warrant the work specified herein for three (3) years, or provide manufacturer's standard warranty for specified products, against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Delamination or deterioration of finish
 - 2. Noisy, rough or difficult operation

3. Failure to meet specified quality assurance requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceeds the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 1. A & J Washroom Accessories
 2. American Specialties, Inc. (ASI)
 3. Bobrick Washroom Equipment, Inc
 4. Bradley Corp.
- B. Specifications are based on products of Bobrick Washroom Equipment, Inc., (281) 362- 7515.

2.02 COMPONENTS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 1. Grind welded joints smooth.
 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Stainless Steel:
 1. Stainless Steel Sheet: ASTM A666 Type 302 or 304.
 2. Stainless Steel Tubing: ASTM A269, stainless steel.
 3. Finish: No. 4 satin, unless otherwise specified
 4. Thickness: 22 US Stainless gauge minimum
- C. Chromium Plating:
 1. Method: Over nickel
 2. Standard: ASTM C456, Type SC 2
- D. Mirrors (Framed):
 1. Standard: FS DD-G-451-C, silvering quality No. 1 float or plate
 2. Thickness: 1/4 inch
 3. Backing: Electrolytic cooper
 4. Protection: Padding and filler strips
- E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
- G. Backing: concealed backing to comply with local codes and as required for substrate conditions; or manufacturers standard mounting kits.

2.03 FINISHING

- A. Stainless Steel: No. 4 satin brushed, typical on all accessories, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats vitreous enamel.
- C. Chrome/Nickel Plating: satin finish.
- D. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 - EXECUTION

3.01 MOUNTING LOCATIONS

- A. Comply with ADA and TAS requirements. Refer to drawings. When not shown, submit supplier's recommendations for locations and mounting height before proceeding.

- B. Contractor shall be responsible for supplying all opening, blocking, and other components necessary for installation of all toilet accessories.
- C. Use approved theft-resistant type fasteners.

3.02 SCHEUDLE

- A. As a quality standard, Model Numbers shown which are not Owner furnished are products of Bobrick Washroom Equipment, Inc.
- B. WASHROOM EQUIPMENT
 - 1. SD - Soap Dispensers:
 - a. Mounting: Surface.
 - b. Model No.: B-2112.
 - c. Locations: One (1) at each lavatory. Refer to drawings.
 - 2. MI - Mirrors:
 - a. Mounting: Surface.
 - b. Model No.: B-290.
 - c. Size/Locations: 24 inches x 36 inches, unless shown otherwise. One (1) at each lavatory. Refer to drawings.
 - 3. TP - Toilet Paper Dispenser:
 - a. Mounting: Surface.
 - b. Model No.: B-265.
 - c. Locations: One (1) at each water closet. Refer to drawings.
 - 4. GB - Grab Bars: (At Typical Accessible Toilet Stalls)
 - a. Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
 - b. Clearance: 1-1/2 inch between rail and wall.
 - c. Model No.: B-6806.
 - d. Mounting: Attach with concealed mounting. Mount parallel to floor.
 - e. Location: One (1) 36 inch behind toilet, and one (1) 42 inch long bar at side of toilet, at each accessible stall. Refer to drawings.
 - 5. MP - Mop and Broom Holder:
 - a. Mounting: Surface
 - b. Model No.: B-239 x 34
 - c. Capacity: Four (4) hooks, three (3) mop holders.
 - d. One (1) above mop sink at each custodial room whether indicated or not. Refer to drawings.
 - 6. GB - Grab Bars: (At Accessible Shower)
 - a. Mounting: Surface
 - b. Model: B-6861 modified (24 x 16)
 - c. Location: One (1) at each accessible shower stall. Refer to drawings.
 - 7. FB - Folding Bench:
 - a. Mounting: Surface, reversible.
 - b. Models: B-5181
 - c. Location: One (1) at each accessible shower stall.
 - 8. HK - Clothes Hook:
 - a. Mounting: Surface
 - b. Model No.: B-6717; or equivalent.
 - c. Location: One (1) hook inside door at single toilet rooms, and one (1) hook at each shower location if not included in partition package described below, unless noted otherwise.
 - d. Toilet and Shower Partitions: hook provided by toilet partition manufacturer included in standard hardware package in accordance with Section 10 2113.19 – Solid Polymer Toilet Partitions; unless noted otherwise.
 - 9. SC – Shower Curtains, Rods, and Hooks:
 - a. Model Nos.:

- 1) Rods: B-6047 (36 inches or as indicated)
 - 2) Curtains: 204-2 (42 inches x 72 inches or as required)
 - 3) Hooks: 204-1 (Seven (7) hooks per curtain or as required)
 - 4) Mounting/Location: One (1) at each accessible shower. Refer to drawings.
- b. PT - Paper Towel Dispenser / Trash Receptacle Combination
- 1) Mounting: Surface
 - 2) Model No.: B-3949
 - 3) Locations: Refer to drawings.

END OF SECTION

SECTION 10 4413
FIRE EXTINGUISHER AND CABINETS

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and technical data to indicate specification compliance.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Larsen's Manufacturing Co.
 - 2. The Williams Bros. Corporation of America
 - 3. L. Industries, Inc.
 - 4. Potter-Roemer

2.02 MATERIALS

- A. Fire Extinguishers (FE):
 - 1. Models/Types:
 - a. Multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series.
 - 2. Provide initial inspection tag for each extinguisher.
 - 3. Cabinet not required, mount to wall using required mounting hook.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fire extinguishers and cabinets in openings in accordance with manufacturer's printed instructions.
- B. Install fire extinguishers and cabinets where indicated on the drawings, or if not indicated, in locations required by governing code and as directed by Owner.

END OF SECTION

SECTION 10 7500 FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- E. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flagpoles:
 1. Concord American Flagpole; Internal - Independence: www.concordamericanflagpole.com/#sle.
 2. Pole-Tech Co, Inc; ____: www.poletech.com/#sle.
 3. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

2.02 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001
 1. Material: Aluminum.
 2. Design: Cone tapered.
 3. Mounting: Ground mounted type.
 4. Nominal Height: 30 ft; measured from nominal ground elevation.

2.03 POLE MATERIALS

- A. Aluminum: ASTM B241/B241M , 6063 alloy , T6 temper.

2.04 ACCESSORIES

- A. Finial Ball: Aluminum, 6 inch (150 mm) diameter.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Cleats: 9 inch (230 mm) size, aluminum with galvanized steel fastenings, one per halyard.
- D. Halyard: 5/16 inch (8 mm) diameter nylon, braided, white.
- E. Primer: Zinc chromate type.

2.05 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch (1.52 mm) steel, galvanized, depth of 18 inches.
- B. Pole Base Attachment: Sleeve; steel base with base cover.

2.06 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
- C. Aluminum: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 INSTALLATION

- A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.
- B. Fill foundation tube sleeve with concrete specified in Section 03 3000.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch (25 mm).

3.04 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 01 9100
BUILDING SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements and Basis-of-Design documentation are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of test equipment, instrumentation, and tools for commissioning.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements

1. Section Special Procedures - LEED Certification, if applicable
2. Section Closeout Procedures
3. Section Operation and Maintenance Data
4. Section Plumbing Systems Commissioning
5. Section Special Conditions for All Mechanical Work
6. Section Mechanical Systems Commissioning
7. Section Instrumentation and Controls for HVAC
8. Section Testing, Adjusting and Balancing
9. Section Electrical Systems Commissioning

1.3 DEFINITIONS AND ABBREVIATIONS

- A. Definitions set forth in the General Conditions, AIA Document A201, are applicable to this Section. In addition, the following definitions shall apply to the terms used in this section.
 1. **"Acceptance Phase"** – Phase of construction after start-up and initial checkout when functional performance tests, O&M documentation review, and training occurs.
 2. **"Approval"** – Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
 3. **"Architect / Engineer (A/E)"** – The prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer / engineer, plumbing designer / engineer, and the electrical designer / engineer.
 4. **"Basis of Design"** – The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions, and methods chosen to meet the design intent.
 5. **"Commissioning Authority (CxA)"** – An independent agent, not otherwise associated with the A/E team members or the Contractor/Construction Manager, though he / she may be hired as a subcontractor to them. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role.
 6. **"Commissioning Plan"** – An overall plan, developed before or after bidding, that provides the structure, schedule, and coordination planning for the commissioning process.
 7. **"Contract Documents"** – The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments,

- contracts, Cx Plan, etc.).
- 8. **“Contractor”** – The prime contractor for this project.
 - 9. **“Control System”** – The central building energy management control system.
 - 10. **“Construction Manager (CM)”** – Primary contractor for the project if defined as such in the Owner/Contractor Agreement.
 - 11. **“Data-logging”** – Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data-loggers separate from the control system.
 - 12. **“Deferred Functional Tests”** – FPT’s that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.
 - 13. **“Deficiency”** – A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
 - 14. **“Design Intent”** – A dynamic document that provides the explanation of the ideas, concepts, and criteria are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
 - 15. **“Design Narrative”** or “Design Documentation” – Sections of either the Design Intent or Basis of Design.
 - 16. **“Factory Testing”** – Testing of equipment on-site or at the factory by factory personnel with an Owner’s representative present.
 - 17. **“Field Installation Verification (FIV)”** – Verification of all installed systems for compliance to plans and specification. These inspections are to be described in detail in the commissioning plan. Primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels, gages in place, balancing devices in place, etc.).
 - 18. **“Functional Performance Test (FPT)”** – Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system’s sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) must be completed prior to commencing the FPT. TAB’s primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT’s are performed after Field Installation Verification (FIV) and Operational Performance Tests (OPT) are complete.
 - 19. **“Indirect Indicators”** – Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
 - 20. **“Manual Test”** – Using hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).
 - 21. **“Monitoring”** – The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
 - 22. **“Non-Compliance”** – see Deficiency.
 - 23. **“Non-Conformance”** – see Deficiency.
 - 24. **“Operational Performance Test (OPT)”** – Verification of proper start-up of all equipment and systems to be commissioned. These tests are to be described in detail in the commissioning plan.
 - 25. **“Over-written Value”** – Writing over a sensor value in the control system to see the response of a system (e.g. changing the outside air temperature value from 50 F to 75 F to verify economizer operation). See also “Simulated Signal.”

26. **“Owner-Contracted Test”** – Tests paid for by the Owner outside the Contractor/Construction Manager’s contract and for which the CxA does not oversee. These tests will not be repeated during the functional performance testing.
 27. **“Phased Commissioning”** – Commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order to minimize the total construction time.
 28. **“Project Manager (PM)”** – The contracting and managing authority for the owner over the design and construction of the project.
 29. **“Sampling”** – Operational or functional testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Part 3 Execution for details.
 30. **“Seasonal Performance Tests”** – FPT that are deferred until the system(s) will experience conditions closer to their design conditions.
 31. **“Simulated Condition”** – Condition that is created for the purpose of testing the response of a system (e.g. applying a hair blower to a space sensor to see the response in a VAV box).
 32. **“Simulated Signal”** – Disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and DDC system to simulate a sensor value.
 33. **“Specifications”** – The construction specifications of the Contract Documents.
 34. **“Startup”** – The initial starting or activating of dynamic equipment, including executing OPT’s.
 35. **“Subs”** – The subcontractors to the Contractor/Construction Manager who provide and install building components and systems.
 36. **“Test Procedures”** – the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
 37. **“Trending”** – Monitoring using the building control system.
 38. **“Vendor”** – Supplier of equipment.
 39. **“Warranty Period”** – Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.
- B. Abbreviations. The following are common abbreviations used in the Specifications and in the Commissioning Plan.
1. A/E: Architect and design engineers.
 2. CxA: Commissioning Authority
 3. CC: Controls Contractor
 4. CM: Construction Manager. Primary contractor for the project if defined as such in the Owner/Contractor Agreement.
 5. Cx: Commissioning
 6. Cx Plan: Commissioning Plan document
 7. DB: Design Build Contractor
 8. EC: Electrical Contractor
 9. FIV: Field Installation Verification
 10. FPT: Functional Performance Test
 11. O & M: Operation and Maintenance
 12. MC: Mechanical Contractor
 13. OPT: Operational Performance Test
 14. PM: Project Manager (of the Owner)
 15. Subs: Subcontractors to the General
 16. TAB: Test and Balance Contractor

1.4 QUALITY ASSURANCE

- A. Commissioning Agent Qualifications: The Firm and/or the designated Commissioning Agent shall have a minimum of (5) years’ experience in providing Total Building

Commissioning Services and shall be regularly employed as a Commissioning Provider. The Firm and/or designated Commissioning Agent shall have been the principal Commissioning Agent on at least three (3) comparable projects that have been successfully completed within the previous five (5) years.

- B. The Commissioning Agent shall have current engineering knowledge and extensive hands-on field experience regarding building systems; the physical principles of building systems performance; building systems start-ups, test and balance, functional performance testing, and troubleshooting; operation and maintenance procedures; and the building design and construction process.
- C. The Commissioning Firm and/or the designated Commissioning Agent shall have certifications from one of the following industry organizations or a recognized and established approved equal.
 - 1. CBCP – Certified Building Commissioning Professional – Association of Energy Engineers (AEE)
 - 2. CCP – Certified Commissioning Professional – Building Commissioning Association (BCxA)
 - 3. CPMP – Certified Process Management Professional – ASHRAE
 - 4. CXA – Certified Commissioning Authority – AABC Commissioning Group (ACG)
 - 5. NEBB CP – Building Certified Professional Certification – National Environmental Balancing Bureau (NEBB)
 - 6. QCxP – University of Wisconsin-Madison Certification
 - 7. Or an approved Commissioning Firm directed by the Owner.

1.5 SYSTEM DESCRIPTION

- A. Commissioning:
 - 1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance, and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment start-up, control system calibration, point-to-point check out, testing and balancing, performance testing, and owner/operator training.
 - 2. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - a. Perform commissioning in accordance with the criteria and requirements set forth in the USGBC LEED v4 rating system.
 - b. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
 - c. Verify and document proper performance of equipment and systems.
 - d. Verify that O&M documentation left on site is complete.
 - e. Verify that the owner's operating personnel are adequately trained.
- B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- C. Systems to be commissioned: The following systems shall be commissioned in this project.
 - 1. Division 22 – Plumbing
 - a. Domestic hot water generation
 - b. Domestic hot water thermostatic control
 - c. Pumping, boosting and circulation
 - 2. Division 23 - HVAC
 - a. HVAC Air systems
 - b. HVAC Hydronic systems

- c. Building Automation System (BAS-Controls)
- 3. Division 26 Electrical Systems
 - a. Interior and exterior lighting systems
 - b. Lighting systems controls
 - c. Emergency Lighting system
- 4. Flush Plan for EQ 3.2 (Applicable for LEED projects only)

1.6 COORDINATION

- A. Commissioning Team:
 - 1. Commissioning Authority (CxA)
 - 2. Owner's Project Manager (PM)
 - 3. Designated representative of the Owner's (Owner's Rep) Project Management Services Provider
 - 4. Design Build Contractor (DB or Contractor)
 - 5. Architect
 - 6. Design Engineers (particularly the mechanical engineer)
 - 7. Mechanical Contractor (MC)
 - 8. Electrical Contractor (EC)
 - 9. TAB representative (TAB)
 - 10. Controls Contractor (CC)
 - 11. Other installing contractors or suppliers of equipment
 - 12. Owner's building or plant operator/engineer
- B. Management. The CxA is hired by the Design Build Contractor. The CxA directs and coordinates the commissioning activities and the reports to the owner. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling.
 - 1. The CxA will work with the PM according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the PM for scheduling commissioning activities. The Contractor/Construction Manager will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
 - 2. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses more detailed schedules are developed by the CxA.

1.7 COMMISSIONING PROCESS

- A. Commissioning Plan. A draft Commissioning Plan shall be developed by the CxA and will be provided at the scoping meeting. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CxA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand as the project progresses. The final commissioning plan is binding on the Contractor. The Specifications will take precedence over the Commissioning Plan.
- B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during design and construction and the general order in which they occur.
 - 1. Commissioning tasks during design include: evaluating scope and contract, develop specifications and commissioning plans, perform design reviews, assist with preparation of design documents through construction documents as dictated by scope.
 - 2. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.

3. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending to plan, scope, coordinate, schedule future activities, and resolve problems.
4. Equipment documentation is submitted to the CxA during normal submittals, including detailed startup procedures.
5. The CxA works with the subs in developing startup plans and startup documentation formats, including providing the subs with FIV and OPT checklists as a reference of items to be verified by the CxA.
6. In general, the checkout and performance verifications proceeds from simple to complex; from component level to equipment to systems and intersystem levels with FIV and OPT checklists being completed before functional performance testing. The CxA shall provide field installation inspection for each system and subsystem covered in the scope of work for this project and provide an installation observation report weekly to the Contractor / Construction Manager. The report shall cover any installation deficiencies from plans and specifications.
7. The Subs perform startup and initial checkout. The CxA documents that the startup was completed according to the approved plans. This shall include the CxA witnessing startup of selected equipment.
8. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.
9. The procedures are executed by the Subs under the direction of and documented by the CxA.
10. Items of non-compliance in material, installation, or setup are corrected at the Sub's expense and the system retested.
11. The CxA reviews the O&M documentation for completeness.
12. Commissioning is completed before Substantial Completion.
13. The CxA reviews, pre-approves, and coordinates the training provided by the Subs and verifies that it was completed.

1.8 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the plumbing contractor reside in Division 22, the mechanical contractor, TAB, and controls contractor are in Division 23 and those of the electrical contractor in Division 26.
- B. All Parties
 1. Assist in the development of the Final Commissioning Plan
 2. Follow the Final Commissioning Plan
 3. Attend commissioning scoping meeting and additional meetings as necessary.
- C. Architect (of A/E)
 1. Construction and Acceptance Phase
 - a. Attend the commissioning scoping meeting and selected commissioning team meetings.
 - b. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
 - c. Provide any design narrative documentation requested by the CxA.
 - d. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 - e. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 2. Warranty Period: coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.
- D. Mechanical and Electrical Designers/Engineers (of the A/E)
 1. Construction and Acceptance Phase
 - a. Perform normal submittal review, construction observation, as-built drawing

- preparation, etc., as contracted. One site observation should be completed just prior to system startup.
- b. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings, or equipment documentation is not sufficient for writing detailed testing procedures.
 - c. Attend commissioning scoping meetings and other selected commissioning team meetings.
 - d. Participate in the resolution of system deficiencies identified during commissioning according to the contract documents.
 - e. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
 - f. From the Contractors red line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, condenser water, domestic water, steam, and condensate systems, supply, return, and exhaust air systems, and emergency power system.
 - g. Review the FIV and OPT checklists for major pieces of equipment for sufficiency prior to their use.
 - h. Review the FPT procedure forms for major pieces of equipment for sufficiency prior to their use.
2. Warranty Period: Participate in the resolution of non-compliance, non-conformance, and design deficiencies identified during the warranty period commissioning.
- E. Commissioning Authority (CxA): The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance, or deficiencies, but ultimately that responsibility resides with the Contractor/Construction Manager and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document the performance – that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out, and functionally test equipment and systems, except for specific testing with portable data loggers, which shall be supplied and installed by the CxA.
- F. Owner's Representative or Project Management Services Provider
- 1. Construction and Acceptance Phase
 - a. Facilitate the coordination of the commissioning work by the CxA, and, with the Contractor/Construction Manager and CxA, ensure that commissioning activities are being scheduled into the master schedule.
 - b. Review the final Commissioning Plan – Construction Phase.
 - c. Attend commissioning scoping meetings and other selected commissioning team meetings.
 - d. Perform the normal review of Contractor submittals.
 - e. Furnish a copy of all construction documents, addenda, change orders, and approved submittals and shop drawings related to commissioned equipment to the CxA.
 - f. Review and approve the functional performance test procedures submitted by the CxA prior to testing
 - g. When necessary, observe and witness FIV, OPT, FPT of selected equipment.
 - h. Review commissioning progress and deficiency reports.
 - i. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
 - j. Assist the CxA in coordinating the training of owner personnel.

2. Warranty Period: Assist the CxA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.
- G. Owner's Project Manager (PM)
1. Construction and Acceptance Phase
 - a. Manage the contract of the A/E and of the Contractor/Construction Manager
 - b. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan
 - c. Provide final approval for the completion of the commissioning work.
 2. Warranty Period: Ensure that any seasonal or deferred testing and deficiency issues are addressed.
- H. Design Build / Contractor (DB/Contractor)
1. Construction and Acceptance Phase
 - a. Facilitate the coordination of the commissioning work by the CxA, and with the Contractor/Construction Manager and CxA ensure that commissioning activities are being scheduled into the master schedule.
 - b. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
 - c. A representative shall attend the commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process
 - d. Coordinate the training of owner personnel.
 - e. Prepare the O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 2. Warranty Period
 - a. Ensure that Subs execute seasonal or deferred functional performance testing.
 - b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
 3. Plumbing, Mechanical, TAB, Controls, Electrical Contractor/s
 - a. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
 - b. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.
 - c. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
 1. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
 2. The Commissioning Agent may request further documentation necessary for the commissioning process.
 3. This data request may be made prior to normal submittals.
 - d. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
 - e. Provide limited assistance to the CxA in preparing a full start-up and initial checkout plan using manufacturer's start-up procedures. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review.
 - f. Perform all completed start-up and system operational checkout procedures in the presence of the CxA.

- g. Address current A/E punch list items before functional testing.
- h. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.
- i. Perform functional performance testing under the direction of the CxA for specified equipment in this section. Assist the CxA in interpreting the monitoring data, as necessary.
- j. Correct deficiencies (difference between specified and observed performance) as interpreted by the CxA, PM and A/E and retest the equipment.
- k. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
- l. Provide training of the Owner's operating personnel as specified.
- m. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- 4. Warranty Period
 - 1. Correct deficiencies and make necessary adjustments to O&M manual and as-built drawings for applicable issues identified in any seasonal testing.
- I. Equipment Supplier
 - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - 2. Assist in equipment testing per agreements with Subs.
 - 3. Include all special tools, instruments, and software required for testing equipment according to these Contract Documents in the base bid pricing, except for stand-alone data-logging provided by the Cxa.
 - 4. Review test procedures for equipment installed by factory representatives.
 - 5. Ensure that any seasonal or deferred testing and deficiency issues are addressed during the warranty period.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and DDC system in Division 23, except for equipment specific to and used by TAB in their contractor responsibilities.
- B. Special equipment, tools, instruments, software, (only available from vendor specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone data-logging equipment that may be used by the Cxa.
- C. Data-logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply temperature sensors and digital thermometers shall have an accuracy of $\pm 0.7^\circ F$ with a resolution of $0.1^\circ F$. Water Pressure sensors shall have an accuracy of $\pm 2\%$ of reading. All instruments shall be calibrated annually.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting. Within 60 days of commencement of construction, the CxA will schedule, plan, and conduct a commissioning scoping meeting with the entire commissioning team in

attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Draft Commission Plan to its "final" version, which will also be distributed to all parties.

- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with the particular Subs.

3.2 REPORTING

- A. The CxA will provide regular reports to the PM, depending on the management structure, with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the Commissioning Plan.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS

- A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation that the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequence of operation, O&M data, performance data, any performance test procedures, control drawings, user interface graphics for each system, and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.
- B. The CxA will review submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The CxA will notify the PM or A/E as requested of items missing or areas that are not in conformance with Contract Documents and which require resubmission.
- C. The CxA may request additional design narrative from the A/E and Controls Contractor depending on the completeness of the design intent documentation and sequences provided with the specifications.
- D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review them.

3.4 FIELD INSTALLATION VERIFICATION AND OPERATIONAL PERFORMANCE TESTS

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.3, Systems to be commissioned.
- B. General. FIV's and OPT's are important to ensure that the equipment and systems are hooked-up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full FIV checkout. No sampling strategies are used. FIV's and OPT's for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all

equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. The contractor is responsible to perform the start-up procedures of selected equipment in the presence of the CxA.

1. The CxA develops the FIV and OPT checklists and procedures. These checklists indicate required procedures to be executed as part of start-up and initial checkout of the systems and the party responsible for their execution.
 2. These checklists and tests are provided by the CxA to the Contractor for reference during the construction process.
 3. The subcontractor responsible for the purchase of the equipment assists in the development of the full start-up plan by combining (or adding to) the CxA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The full start-up plan (at a minimum) shall consist of the following:
 - a. The CxA's OPT checklist
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals.
 - c. The manufacturer's normally used field checkout sheets.
 4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
 5. The full start-up procedures and the approval form may be provided to the PM for review and approval, depending on management protocol.
- D. Controls System Verification
1. The operation of all control system components shall be verified in the presence of the CxA.
 2. All procedures used shall be fully documented on the OPT checklists clearly referencing the procedures followed and written documentation of initial, intermediate, and final results.
 3. All control point OPT tests shall be verified through the graphic front end software.
 4. All sensors and analog inputs shall be calibrated by manufacturer's standard procedures and to project calibration tolerances.
 5. All analog outputs, actuators, and valves shall be ranged for correct action to the control signal.
- E. Execution of FIV and OPT Procedures.
1. The CxA shall perform regular FIV's throughout the construction period.
 2. Four weeks prior to start-up, the Subs and vendors schedule start-up and checkout with the PM, Contractor/Construction Manager, and CxA. The performance of start-up and checkout are directed and executed by the Sub or vendor in the presence of the CxA.
 3. The CxA shall observe the start-up procedures for each piece of primary equipment.
- F. Deficiency issue log.
1. The CxA shall provide a periodic commissioning issue log clearly listing any deficiencies or areas of concern from any FIV or OPT.
 2. The issue log shall be provided to the PM for distribution to the appropriate parties for review, response, and action. All actions and results will be listed on the issue log for future reference (i.e. nothing is ever deleted).
 3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.5 PHASED COMMISSIONING

- A. The project may require start-up and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting of the CxA, PM, mechanical, TAB, controls, and the Contractor/Construction Manager. Results will be added to the master and commissioning schedules.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is as specified herein.

Objective and Scope

- 1. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional tests will identify areas of deficient performance so they can be corrected, improving the operation, and functioning of the systems.
- 2. In general, each system should be operated through all modes of operation (seasonal, occupied, un-occupied, warm-up, cool-down, part and full load,) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

C. Development of Test Procedures

- 1. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (answer questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment, and warranty protection. The CxA may submit the tests to the A/E for review, if requested.
- 2. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
- 3. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

D. Test Methods

- 1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities, or by stand-alone data loggers. The CxA may substitute specified methods or require an additional method to be executed, other than what was specified, with the approval of the PM. This may require a change order and adjustment in charge to the owner. The CxA will determine which method is most appropriate for tests that do not have a method specified.
- 2. Sampling Multiple identical pieces of non-life-safety or otherwise non-critical equipment with identical factory configured control sequences may be functionally tested using sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference.

E. Coordination and Scheduling

- 1. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the start-up of all equipment and systems. The CxA will schedule functional tests through the Contractor/Construction Manager and affected Subs. The CxA shall direct, witness, and document the functional testing of all equipment and systems. The Subs shall execute the tests.
- 2. In general, functional testing is conducted after FIV's and OPT's have been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems.

The air balancing and water balancing is completed and de-bugged before functional testing of air related or water related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.

- F. Test Equipment. Refer to Part 2 – Products for test equipment requirements.
- G. Problem Solving. The CxA will recommend solutions to problems found, however, the burden of responsibility to solve, correct, and re-test problems is with the Contractor/Construction Manager, Subs, and A/E.
- H. Deferred Testing. If any check or test cannot be completed due to the building structure, required occupancy condition, or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

3.7 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

- A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the PM for review and approval and to the Subs for review. The CxA will include the filled out forms in the O&M manuals.
- B. Non-Conformance
 - 1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the PM on the standard commissioning issues log.
 - 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
 - 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the PM.
 - 4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - 1. If the deficiency can be easily corrected it shall be corrected and the commissioning shall proceed.
 - 2. The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible or the repair will take more than one hour:
 - 1. The deficiency shall be documented on the issue log or the test check sheet with the Sub's response and a copy given to the Contractor/Construction Manager and to the Sub representative assumed to be responsible.
 - 2. Resolutions are made at the lowest management level possible.
 - 3. The CxA documents the resolution process.
 - 4. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 - 5. Cost of re-testing.
 - a. The cost for the Sub to re-test a OPT or FPT, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for re-

- testing costs shall be negotiated with the Contractor/Construction Manager.
- b. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CxA will direct the re-testing of the equipment once at no charge to the Contractor/Construction Manager for their time. However, the CxA's time for a second re-test will be charged to the Contractor/Construction Manager, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxA to direct any re-testing required because a specific FIV or OPT item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the Contractor/Construction Manager, who may choose to recover costs from the party responsible.
- 6. The contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 - 7. The CxA retains the original non-conformance forms until the end of the project.
 - 8. Any required re-testing by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the PM.
- D. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the PM, if necessary. The CxA recommends acceptance of each test to the PM using a standard form. The PM gives final approval on each test using the same form, providing a signed copy to the CxA and the contractor.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. Standard O&M Manuals
- 1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 78 00. Special requirements for the controls contractor and TAB contractor shall be as specified in Div 23.
 - 2. CxA Review. Prior to substantial completion, the CxA shall review the O&M manuals, documentation, and final as-built drawings for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the PM, A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the PM, or A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.
- B. Commissioning Final Report
- 1. Final Report Details. The final commissioning report shall include an executive summary, LEED commissioning statement sheet, list of participants, and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the FIV, OPT, and FPT completed check sheets. The report shall also include all issue logs and commissioning communication.
 - 2. Other documentation will be retained by the CxA.

3.9 TRAINING OF OWNER PERSONNEL

- A. The Contractor/Construction Manager shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

- B. The CxA shall be responsible for overseeing and reviewing the content and adequacy of the training of Owner personnel for commissioned equipment and systems.
1. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. All training methods shall include a classroom lecture and an actual operational demonstration of start-up, tear down, and maintenance procedures, as applicable and appropriate. A sample of elements contained in the plan is as follows:
 - a. Equipment covered
 - b. Intended audience
 - c. Location of training
 - d. Objectives
 - e. Subjects covered
 - f. Duration of training on each subject
 - g. Instructor name, company, and qualifications
 2. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
 3. The CxA develops an overall training plan and coordinates and schedules, with the Contractor/Construction Manager, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the PM using standard form. The PM also signs the approval form.

END OF SECTION

SECTION 22 0006
PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove or Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner cleaned, packaged, and ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
 - 1. Coordinate with Owner's representative, who will establish special procedures for removal and salvage.

1.4 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services (including but not limited to: Gas, Water, Fire Suppression, Chilled Water, Hot Water, Air Conditioning, etc).
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 5. Means of protection for items to remain and items in path of waste removal from building.
- B. Inventory: After selective demolition is complete, submit a list of items that have been salvaged.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Arrange to shut off indicated utilities with utility companies.
 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass

area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Contractor shall terminate demolished pipe and/or ductwork. System shall be capped and insulated per new work specification.
- F. Contractor shall remove any abandoned piping and/or ductwork in area of construction during the demolition process.
- G. Unforeseen Conditions
 1. Any unforeseen utilities found during construction that directly affect any trade must be brought to the engineer's attention via RFI.
 2. All existing conditions must be clearly annotated on the As-Built drawings.

- H. Repair any walls, floors or roofs that piping, ducts or equipment have been removed from (or through). Patch with similar materials to match finish and color (paint to match). If paint cannot be matched, repaint entire wall or surface.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 22 0100
SPECIAL CONDITIONS FOR ALL PLUMBING WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section covers the general provisions of the plumbing specifications applicable to the following systems:
 1. Plumbing.
- B. The use of the word plumbing in the body of the various specifications sections shall be interpreted to include all the aspects of all of the systems referenced in the Plumbing Specifications.

1.2 DRAWINGS

- A. These specifications are accompanied by drawings of the building and details of the installations showing the locations of equipment, piping, etc. The drawings and these specifications are complementary to each other; requirements described in one or the other shall be considered binding as if described in both.
- B. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Owner's Representative for approval. No departures shall be made without prior written approval by the Owner's Representative.
- C. There are intricacies of construction which are impractical to specify or indicate in detail; means and methods for performing such work shall adhere to commonly accepted industry standards.
- D. It is the Contractor's responsibility to properly use all information found on the Architectural, Structural, Mechanical, Plumbing and Electrical drawings and applicable shop drawings where such information affects his work.
- E. For new buildings, all final dimensions shall be scaled from the drawings, unless otherwise noted. For work associated with existing buildings (renovations and additions), all final dimensions shall be field verified.

1.3 CONSTRUCTION REQUIREMENTS

- A. The architectural, civil, structural, mechanical, electrical, plumbing, and fire protection drawings, and specifications are all part of the Contract Documents. In many instances there are details described in another trade's drawings that are not necessarily included or referenced in the plumbing drawings. It is the Contractor's responsibility to review in detail all parts of the Contract Documents prior to submitting a bid. Failure to comply with this requirement shall not relieve the Contractor of responsibility or be used as cause for additional compensation because architectural, structural, or electrical details were not included in the plumbing drawings.
- B. It is the intent of the Contract Documents to provide complete and fully functional installation in every respect. Material and/or construction details not specifically described in the Contract Documents, but commonly considered incidental to the industry, are required by the Contractor.
- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to comply with Codes, to facilitate the work of other trades, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated satisfactory operating installation.
- D. The plumbing, electrical and mechanical drawings are schematic in nature and do not show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of ordinances and structural and architectural conditions.

- E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid compromising structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to building lines unless otherwise noted.
- F. When the plumbing drawings do not give exact details as to the elevation of pipe or equipment, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and exposed conduit, are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The plans do not show all required offsets, control lines, pilot lines, and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain to insulate will not be permitted.
- G. Final placement of serviceable equipment shall be carefully coordinated with all other trades to ensure sufficient clearance for maintenance according to manufacturer's recommendations. Lubricating orifices and adjustable components shall be easily accessible. Piping, conduit, valve stems, cabling and other building systems shall not interfere with service space.
- H. Location of Exposed Devices
 - 1. All exposed devices (sprinkler heads, medical gas outlets, plumbing rough-ins, lights, outlets, communication devices, etcetera) shall be referenced to fixed data points that are coordinated with all trades; shall be located to present symmetrical arrangements with respect to the fixed data point; and shall facilitate the proper arrangements of acoustical ceiling tiles. Fixed data points shall include such features as wall and ceiling lines, soffits, balanced border widths, masonry joints, etc. Devices located in acoustical ceiling tiles shall occur symmetrically in tile joints or in the centers of whole tiles. The final determination of the exact location of each outlet and the arrangements to be followed shall be acceptable to the Owner's Representative.
 - 2. The drawings schematically indicate locations of the exposed devices. Final locations shall be determined by carefully coordinating the drawings pertaining to each trade. Where conflicts are identified, Owner's Representative shall determine final location. The Owner reserves the right to make any reasonable change in location of any device before installation, without additional cost to the Owner or the Architect.

1.4 QUALIFICATIONS

- A. Contractor must have minimum of five years experience installing commercial, plumbing and piping systems similar to those described in these Contract Documents.
- B. Contractor must be licensed and hold a current contracting license that has been valid for a minimum of five years in the State of Texas.
- C. Contractor must be able to bond work for payment and performance of work being bid. Contractor's bonding agency shall have a Best's insurance rating of A or A+.

1.5 MATERIAL AND EQUIPMENT REQUIREMENTS

- A. Manufacturer's Instructions: The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner's Representative in writing of any conflict between the requirements of the Contract Documents and the manufacturer's direction and shall obtain the clarification of the Owner's

- Representative before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such clarification by the Owner's Representative, he shall bear all costs arising in connection with the correction of the deficiencies.
- B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage and from surrounding work.
 - C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
 - D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of Underwriters Laboratories, Inc. applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
 - E. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and model-identification number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
 - F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
 - G. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.
 - H. Drive Guards: For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling units casings. Guards shall be constructed of sheet steel, cast iron, expanded metal, or wire mesh rigidly secured so as to be removable without disassembling pipe duct or electrical connection to equipment. Provide a 1-inch diameter hole in each drive guard at each shaft center to allow access for speed measurement.
 - I. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner's Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, Architect, or Engineer.
 - J. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

- K. Spare Parts Data: As soon as practicable after approval of materials and equipment and, if possible, not later than four months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and sources of supply, a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the Contract, and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days at the particular installation. The foregoing shall not relieve the Contractor of any responsibilities under the warranty specified.

1.6 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, structures, utilities, equipment, systems, facilities, and local requirements. The submission of bids shall be deemed evidence of such visits. All proposals shall take these existing conditions into consideration, and the lack of specific information shall not relieve the Contractor of any responsibility.

1.7 UTILITY LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered separately from the Contract Documents, as a general guide only, without guarantee as to accuracy. Examine the site, the locations, and availability of all utilities and services required for their relation to the work. Verify the location of all existing site utilities with each responsible utility company or applicable party. The Contractor shall repair all damage to existing utilities, whether indicated on the drawings or not, at his sole expense.

1.8 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

- A. Permitting Fees: Contractor shall pay for all fees associated with permits required by municipal authorities having jurisdiction.
- B. Tapping and Impact Fees: Contractor shall pay for all fees associated with tapping into municipal utility mains, including sanitary sewer, natural gas and domestic water. Impact fees will be paid for by the Owner.
- C. Compliance: The Contractor shall comply in every respect with all requirements of local authorities having jurisdiction, including building inspections, fire marshal, local ordinances and codes, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of a higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities.
- D. Utilities: The Contractor shall coordinate with the various utility companies involved in this project and shall provide required utility relocations, extensions, modifications, and/or changes (complete in all respects) as described in the Contract Documents. Contractor shall verify the location of all existing utilities with the applicable Utility Company. The Contractor shall be responsible for all damages to existing utilities, whether indicated on drawings or not, and repair all damage to existing utilities as acceptable to the affected Utility Company.
- E. Certification: Prior to final acceptance, the Contractor shall furnish a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract. Any additional labor costs incurred as a result of a substitution shall be the Contractor's responsibility.

1.9 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing or replacing such loss or damage.

The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being performed under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc. to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.10 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. No substitution of materials or equipment herein specified or called for on the drawings will be permitted, except by written permission of the Owner's Representative. Where several makes of equipment or material are mentioned, any item named may be bid upon provided it meets space, capacity specifications, and other requirements.

1.12 SUBMITTALS

A. Submittals for Review:

1. As soon as practical or within 30 days after the date of contract award or notice to proceed, and before purchasing or starting installation of any materials or equipment, the Contractor shall submit for review sufficient material and equipment data to indicate that all requirements of the specifications have been met and samples shall be furnished when requested. All manufacturer's data used as part of the submittal shall have all non-applicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
2. Four (4) copies of the submittal list and detailed submittals (for the Owner's and A/E's use) shall be submitted to the Owner's Representative. The Contractor is requested to include a minimum of three (3) additional copies for insertion in the project's Owner's Manuals at the completion of the project, and the number of additional copies the Contractor requires for his and his subcontractor's use during the project's construction. The detailed submittals shall be accompanied by the same number of sets of pictorial and descriptive data derived from the manufacturer's catalogs and sales literature or incorporated in the shop drawings. The Contractor may provide a detailed submittal on any item even though not required by the Owner's Representative.

B. Format

1. Submittals shall be in pdf format. The first page shall have a cover sheet inserted with the title "PLUMBING SUBMITTALS" centered in large print. Below the title shall be printed the name of the project, the date, the project location, the name and address of the contractor, the name and address of the subcontractor and the name and address of the engineer(s) in smaller print.
2. Provide a Table of Contents at the beginning of the binder that summarizes the information being submitted according to specification section.
3. Submittals shall be tab divided by specification section; **all sections** identified in the project specifications shall have a tab. When no information is being provided concerning a particular specification section, insert a single dated sheet that explains the circumstances.
4. **Loose-leaf or piecemeal submittals are not acceptable and subject to rejection unless prior approval has been granted by the Engineer.**

C. Content:

1. The Contractor shall prepare or cause to be prepared shop drawings, product data, materials and equipment lists, diagrams, data, samples, and other submittals as required by the contract documents, hereinafter referred to as "Submittal Data." The Contractor shall review and approve all submittal data for compliance with the contract documents, manufacturer's recommendations, adequacy, clearances, code compliance, safety, and coordination with associated work.
2. The Contractor shall submit approved submittal data to the Owner's Representative for review and comment as to general conformance with the design concept and general compliance with information given in the contract documents. Owner's Representative's review shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with other trades or work, or construction safety and precautions, all of which are the sole responsibility of the Contractor.

3. The Contractor shall clearly and specifically identify and call to the attention of the Owner's Representative any deviation from the contract documents for which Owner acceptance is desired. The responsibility for such a deviation accepted by the Owner shall remain with the Contractor.
 4. Timeliness: The burden of timeliness in the complete cycle of submittal data is on the Contractor. The Contractor shall allow a minimum of two (2) weeks' time frame for review of each submission by the Owner's Representative. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submission cycles on nonconforming materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not justify any request for scheduled construction time extensions or extra compensation.
 5. Work performed in accordance with approved submittal date that is not in accordance with the Contract Documents and did not have the specific acceptance of the Owner's Representative shall be replaced at Contractor's cost.
- D. Re-submittals
1. Re-submit entire submittal in accordance with afore mentioned format and content requirements. **Loose-leaf or piecemeal re-submittals are not acceptable.** New and/or revised data for each section shall be prefaced with a colored (yellow, pink, orange, etc) cover sheet that identifies (in a word or two) the materials and/or equipment being re-submitted. Typeset the words "REVISED SUBMITTAL NO. 1 (or 2, 3 as applicable)" centered at the bottom of the cover sheet.
 2. Subsequent re-submittals (second and third, if necessary) shall have different colored cover sheets to distinguish between the various re-submittals.
 3. Include a cover letter at front of binder that specifically responds to each "REVISE AND RE-SUBMIT COMMENT" or "REJECTED" comment by number. Example responses would include the following:
 - a. RESPONSE: "Please see attached re-submittal."
 - b. RESPONSE: "Will be re-submitted at a later date."
 - c. RESPONSE: "Requirement for (xxxxxx) was deleted in Addendum No. 2."
 - d. RESPONSE: "Exception requested based on Section xx, Paragraph x.x.x."
- E. These paragraphs related to Plumbing submittal data supersede any conflicting requirements contained in Division 01 sections.

1.13 CONTRACTOR CERTIFICATION OF SUBMITTAL DATA

- A. The Contractor shall provide the following certification with all submittal data furnished to the Owner's Representative for review and comment.

Project Title:

Description of Submittal Data:

This is to certify that the above-described submittal data has been reviewed and is approved for compliance with the Contract Documents, manufacturer's recommendation, adequacy, clearances, code compliance, safety, and coordination with other trades and/or work except as follows: (list "none" or itemize and explain). In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

Name and Company

1.14 ACCEPTANCE OF MATERIALS AND EQUIPMENT

- A. All equipment installed on this project shall have **local (within 125 miles)** representation, local factory-authorized service, and a local stock of repair parts. This requirement is essential and will be strictly reviewed by the Owner's Representative prior to concurrence with the Contractor's approval for all submittals covered by Plumbing Division of this Specification.
- B. NOTICE: The Contractor is responsible for providing materials and equipment that conform to the requirements of the project manual in every respect unless a deviation has been "accepted" in writing. Removal of any nonconforming materials and equipment and the replacement with conforming materials and equipment shall be at the Contractor's sole expense, regardless of when nonconformance was discovered.
- C. Approval of materials and equipment shall be based on manufacturer's published data and shall be tentatively subject to the submission of complete shop drawings which comply with the contract documents. Approval is also dependent upon the existence of adequate and acceptable clearances for entry, servicing, and maintenance.
- D. Approval of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Owner's Representative has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- E. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of approved manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

1.15 SITE OBSERVATION

- A. Site observation by the Architect, Engineer, and/or Owner's Representative is for the express purpose of verifying compliance by the Contractor with the contract documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.16 SUPERVISION

- A. In addition to the Superintendent required under the conditions of the contract, each subcontractor shall keep a competent superintendent or foreman on the job at all times.
- B. It shall be the responsibility of each superintendent to study all plans and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and, before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the jobsite by the superintendents involved. Where interferences cannot be resolved without major changes to the plans, the matter shall be referred to the Owner's Representative for comments.

1.17 OPERATION PRIOR TO COMPLETION

- A. When any piece of equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation and has the written permission of the Owner's Representative to do so. The warranty period shall not commence, however, until such time as the equipment is operated for the beneficial use of the Owner or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

1.18 MANUFACTURER'S RECOMMENDATIONS

- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly

notify the Owner's Representative, in writing, of any conflict between the requirements of the contract documents and the manufacturer's directions and shall obtain the Owner's Representative's comments before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or applicable comments from the Owner's Representative, he shall bear all costs arising in connection with the correction of such deficiencies.

1.19 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Before final acceptance of the work, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

- B. Check inspections shall include plumbing, heating, air conditioning, ventilating, mechanical control and electrical equipment, and such other items hereinafter specified or specifically designated by the Owner's Representative.

1.20 OPERATING AND MAINTENANCE INSTRUCTION

- A. The Contractor shall prepare for the owner's manual hereinafter specified complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc. for each item of equipment. These are to be assembled as hereinafter specified for owner's manual.
- B. In addition, the Contractor shall provide the service of a competent engineer or a technician acceptable to the Owner's Representative to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of sufficient duration to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, acknowledged by the Owner, stating the dates of instruction and personnel to whom instructions were given.
- C. Additional diagrams, operating instructions, etc. shall be provided as specified hereinafter in the other sections of these specifications.

1.21 MATERIAL AND EQUIPMENT SCHEDULES

- A. Contractor shall refer to both drawings and specification for schedules. Where reference is made to items "scheduled on drawings" or "scheduled in specifications," same shall include schedules contained in both the drawings and the specifications. The Contractor's attention is directed to the various specification sections and drawings for schedules.

1.22 APPLICABLE CODES AND STANDARDS

- A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications, except as may be hereinafter specifically modified in these specifications and associated drawings.
 1. National Fire Protection Association Standards (NFPA):
 - NFPA 10 - Portable Fire Extinguishers
 - NFPA 54 - National Fuel and Gas Code
 - NFPA 70 - National Electrical Code
 - NFPA 90A - Air Conditioning Systems
 - NFPA 101 - Life Safety Code
 - NFPA 255 - Method of Test of Surface Burning Characteristics of Building Materials

- Local and State Health Code (TDSH)
 - 2. American National Standards Institute (ANSI):
 - 15-78 - Safety Code for Mechanical Refrigeration
 - C.2 - 1984 National Electrical Safety Code
 - A117.1 - Handicapped Code
 - 3. American Society of Mechanical Engineers (ASME): Section IV, V, CSD-1
 - 4. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these specifications.
 - 5. American Water Works Association (AWWA): All applicable manuals and standards.
 - 6. Sheet Metal and Air Conditioning Contractors National Associate, Inc, (SMACNA): All applicable manuals and standards.
 - 7. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.
 - 8. American Society of Testing Materials (ASTM): All applicable manuals and standards.
 - 9. National Electrical Manufacturers' Association (NEMA): All applicable manuals and standards.
 - 10. Occupational Safety and Health ACT (OSHA):
 - National Sanitation Foundation - Standard No. 2
 - 11. American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE):
 - 90-80 Energy Conservation in New Building Design
 - 2001 ASHRAE Handbook of Fundamentals
 - 12. Americans with Disabilities Act, 1990
 - 13. American Gas Association (AGA)
 - 14. Underwriters Laboratories, Inc. (UL)
 - 15. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)
 - 16. Applicable State Building Codes (International Building Codes, as amended):
 - 17. Applicable State Mechanical Code (International Mechanical Code, as amended).
 - 18. Applicable State Plumbing Code (International Plumbing Code, as amended).
 - 19. Applicable State Energy Code (International Energy Conservation Code, as amended).
- B. All materials and workmanship shall comply with all applicable city, state, and national codes, specifications, and industry standards. All materials shall be listed by the Underwriters Laboratories, Inc. as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.
- C. The contract documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Owner's Representative in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these contract documents, providing no work or fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules, and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.23 DEFINITIONS

- A. Refer to the condition of the contract for Division 1 for additional requirements regarding definitions.
- B. Where "as required" or "as necessary" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the Contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the

Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."

- C. Where "and/or" is used in these specifications or on the drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.

1.24 FINAL INSPECTION

- A. Refer to Division 1 for additional requirements for final inspection.
- B. It shall be the responsibility of the Contractor to personally conduct a careful inspection, assuring himself that the work on the project is ready for final acceptance and developing his own "punchlists," before calling upon the Owner's Representative to make a final inspection. Failure of the Contractor to conduct such inspections and provide the Owner's Representative with a copy of his "punchlists" prior to the final inspection shall be adequate cause for the Owner's Representative to cancel any Contractor-requested final inspection.
- C. In order not to delay final acceptance of the work, the Contractor shall conduct his own "final inspections" prior to requesting the Owner's Representative to "final" the project; will have all necessary bonds, guarantees, receipts, affidavits, etc. called for in the various articles of this specification prepared and signed in advance; and together with a letter of transmittal listing each paper included, shall deliver the same to the Owner's Representative at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc. before preparing same for submission to see that the terms check with the requirements of the specifications.
- D. The final inspection will be made jointly by the Owner's Representative and the Owner.

1.25 REQUIREMENTS FOR FINAL ACCEPTANCE

- A. Requirements for final acceptance shall include but not be limited to the Contractor accomplishing the following:
1. Construction: Complete all construction.
 2. Deficiency Lists: Correct all deficiencies listed at time of Substantial Completion.
 - a. Owner's Manual: Submit at least 30 days prior to final acceptance on (1) copy of the owner's manual for the Owner's Representative's review and comments. Following acceptance, prepare three (3) copies of bound and indexed owner's manual, to be delivered System operating instructions.
 - b. System control drawings.
 - c. System interlock drawings.
 - d. System maintenance instructions.
 - e. Manufacturers', suppliers', and subcontractors' names, addresses, and telephone numbers, both local representatives and manufacturers' service headquarters.
 - f. Equipment operating and maintenance instructions and parts lists.
 - g. Manufacturer's certifications (see Checking and Testing Materials and/or Equipment, this section).
 - h. Contractor's warranty.
 - i. Acceptance certificates of authorities having jurisdiction.
 - j. Log of all tests made during course of work.
 - k. Owner's acknowledgment of receipt of instruction, enumerating items in owner's manual.
 - l. List of manufacturers' guarantees executed by the Contractor.
 - m. Certified performance curves.
 - n. Balance and performance test reports.
 - o. Owner's acknowledgment of items of equipment or accessories indicated or specified to be turned over to Owner.

- p. Verbal, as herein specified.
- q. Posted, framed under glass or plastic laminated:
- 3. At the time of final acceptance, which shall include but not be limited to the following:
- 4. Instructions:
 - a. System operating instructions.
 - b. System control drawings.
 - c. System interlock drawings.
- 5. Record Drawings: Deliver the specified record drawings to the Owner's Representative.

1.26 RECORD DRAWINGS

- A. The Contractor shall maintain a set of contract drawings (black-line prints) at the jobsite on which he shall indicate the installed (as-built) locations of the following:
 - 1. Equipment
 - 2. Main lines of piping and ductwork.
 - 3. Dimensional locations (including depth) of all underground piping, valves and conduits.
- B. Drawings shall be used for construction reference and shall not leave the field office of the jobsite.
- C. Drawings shall include all addenda, ASI's, Change Orders, and existing conditions and equipment that are not reflected in the original contract drawings.
- D. Upon completion of work, the Contractor shall obtain CAD files of the contract drawings from the Owner's Representative and transfer the above as-built information into these files. The as-built files shall be permanently marked "RECORD DRAWINGS" and printed on full-size Mylar sheets. Upon completion, the CAD files shall be transferred to CD in AutoCAD 2007 format. Both the CAD files CD and Mylar drawings shall be submitted to the Owner's Representative as part of the Close-out Submittals.
- E. Refer to Division 1 paragraph entitled "Record Documents" for additional requirements.

1.27 ALLOWANCES

- A. Refer to Division 1 for allowances.

1.28 ALTERNATE PROPOSALS

- A. Alternate proposals are summarized in Division 1 and on the bid proposal form. Refer to all sections of the specifications and the drawings to determine the exact extent and scope of the various alternate proposals as each pertains to the work of the various trades.

1.29 WARRANTY

- A. General: All work performed (including equipment and materials furnished) under the various sections of these specifications shall be 100% warranted, for a period of one (1) year from the date of final acceptance thereof, against defective materials, design, and unauthorized substitution. Upon receipt of note of failure of any part of the guaranteed equipment and/or facilities during the guaranty period, the affected part(s) or facilities shall be replaced promptly with new parts, etc. by and at the expense of the Contractor. Further, the Contractor shall properly obtain, execute, and forward any and all manufacturer's warranties on equipment furnished under the Contract. Refer to Division 1 for additional requirements.
- B. Extended Period: The Contractor shall provide all extended time warranties available from the manufacturer of the equipment provided as standard at no additional cost. This includes all extended warranties where specified with certain equipment as directed in other sections of this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be 51% manufactured in the United States, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.
- C. The responsibility for the furnishing and installation of the proper plumbing equipment and/or material as intended rests entirely upon the Contractor. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

- A. Duct coverings, duct linings, vapor barrier facings, tapes, adhesives, core materials, insulation, jackets, piping (of any sort), and other materials in concealed locations, including any above-ceiling area, shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50. Flame spread and smoke developed ratings shall be in accordance with NFPA Standard No. 255.

2.3 BEARINGS

- A. All ball bearings shall be of radial and/or thrust type and enclosed in a dust and moisture-proof housing.

2.4 MOTORS

- A. The Contractor shall provide all motors required for equipment supplied under each portion of the work. Motors shall be built in accordance with the latest ANSI, IEE, and NEMA standards, shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled.

2.5 STARTING EQUIPMENT

- A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted.

2.6 FIRE AND SMOKE PARTITION, WALL, AND/OR FLOOR PENETRATIONS

- A. Pipe, ductwork, conduit, etc. shall pass through fire- or smoke-rated floors, partitions, walls, or other barriers within a UL-listed assembly which shall maintain the rating of the applicable wall, floor, partition, or barrier.
- B. The Contractor shall review the architectural and structural drawings and determine the location of the fire-rated building elements. Where these elements are penetrated, UL-listed fire-rated penetration assemblies approved by the local authority shall be provided in accordance with the manufacturer's instructions to obtain the required rating.

2.7 FOUNDATIONS / HOUSEKEEPING PADS

- A. General: All special foundations and supports required for the proper installation of equipment and pipe shall be provided as hereinafter specified and under the section of the specifications covering the equipment, unless otherwise indicated on the drawings.
- B. All equipment shall receive concrete housekeeping pads unless otherwise noted. Equipment to be receive pads are to include (but not limited to): boilers, water heaters, water softeners, expansion / compression tanks, filter feeders, water treatment equipment, air compressors, pumps (in addition to inertia bases where required), surge tanks, deareators, etc.

- C. Concrete foundations for the support of equipment such as floor-mounted pumps, equipment, etc. shall be not less than 3 inches high and not less than 4 inches larger (in both directions) than supported unit, unless otherwise noted and shall be poured in forms built of new dressed lumber. All corners of the foundations shall be neatly chaffered by means of sheet metal or triangular wood strips nailed to the form. Pads shall not be laid out directly against walls or structures. 2 inches shall be left available for pad form work. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Allow 1 inch below the equipment bases for alignment and grouting (where applicable). Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with approved shop drawings and shall be reinforced with #4 bars at 12 inches on center both ways (minimum).
- D. Pipe and Conduit Support: All pipes and conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical pipes and conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.

PART 3 - EXECUTION

3.1 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers will be acceptable, it is the responsibility of the Contractor to determine whether the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared when required by the Owner's Representative to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

3.2 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

3.3 PROTECTION

- A. The Contractor shall take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. The Contractor shall protect existing facilities, the work of others, and the premises from any and all damages that may be made possible by the execution of work.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

3.4 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various trades, subcontractors, and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must

pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.

- B. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the jobsite in a clean and safe condition. At the end of each day's work, each trade shall properly store all of its tools, equipment, and materials and shall clean its debris from the job. Upon the completion of the job, each trade shall immediately remove all of its tools, equipment, any surplus materials, and all debris caused by its portion of the work.

3.5 PRECEDENCE OF MATERIALS AND COORDINATION OF WORK

- A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each subcontractor and/or trade shall be responsible for the proper fitting of his material and apparatus into the building.
- B. The work of the various trades shall be performed in the most direct and workmanlike manner without hindering or handicapping the work of other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Where space requirements conflict, the following order or precedence shall, in general, be observed:
1. Building lines.
 2. Structural members.
 3. Light fixtures.
 4. Soil and drain piping.
 5. Condensate drains.
 6. Vent piping.
 7. Supply, return, and outside air ductwork.
 8. Exhaust ductwork.
 9. HVAC water and steam piping.
 10. Steam condensate piping.
 11. Fire protection piping.
 12. Natural gas piping.
 13. Domestic water (cold and hot).
 14. Refrigerant piping.
 15. Electrical conduit.
- C. Coordinate all major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Coordinate space requirements for installation and access. Verify the following:
1. Clearance for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 2. Equipment and accessory service connections and support details.
 3. Fire-rated wall and floor penetrations.
 4. Scheduling, sequencing, movement and positioning of large equipment into building during construction.
 5. Access panel and door locations.
 6. Clearances between building openings and VTR's/Flues.
- D. The light fixture grid layout as indicated on the drawings must be maintained. This Contractor shall refer to all light fixture plans and details indicated on the drawings and shall coordinate the location of dampers, supply grilles, return air grilles, sprinkler heads, etc. with the location of the light fixtures to assure proper access to all items in a manner acceptable to the Owner's Representative.
- E. The electrical trades shall locate all junction boxes, pull boxes, conduits, etc. to avoid interference with the diffusers, dampers, grilles, etc. hereinbefore mentioned. The

mechanical trades shall furnish to all other trades copies of approved ductwork shop drawings to assist in the coordination of the rough-in and installation of all items of work.

3.6 CONNECTIONS FOR OTHERS

- A. This Contractor shall rough-in for and make all water, sewer, electrical, etc. connections to all fixtures, equipment, machinery, etc. provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, connectors, etc.
- C. Provide all air gap fittings required, using materials hereinbefore specified. In each water line serving an item of equipment or piece of machinery, provide a shutoff valve. On each drain without integral trap provide a suitable trap.
- D. All pipe fittings, valves, traps, etc. exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome-plated to match.
- E. Provide all transition pieces, etc. required for a complete installation of equipment provided by others.

3.7 INSTALLATION METHODS

- A. Where to Conceal: All pipes and conduits shall be concealed in pipe chases, walls, furred spaces, below suspended floors, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed Tee structures, or storage spaces, but only where necessary, piping and conduit may be run exposed. All exposed piping and conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping and conduit shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them, in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Owner's Representative for each penetration.
- E. All pipe, conduits, etc. shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes, and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that they shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc. shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
- F. Special Requirements:
 1. There shall be no pipe joints nearer than 12 inches to a wall, ceiling, or floor penetration unless pipe joint is a welded or mechanically-coupled-type joint.
 2. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Owner's Representative and resolve the conflict prior to erection of any work in the area involved.
 3. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangements can be made for an inspection of the above-ceiling area about to be "sealed off." The Contractor

shall give as much advance notice as possible up to ten (10) working days, but in no case less than five (5) working days.

4. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the plumbing systems, and any other special above-ceiling systems such as pneumatic tube. The ceiling supports (tee bar or lath) should be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling material shall be installed until the deficiencies listed from this inspection have been corrected to the satisfaction of the Owner's Representative.

3.8 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc. resulting from work in existing construction or where made necessary by failure to provide proper openings or recesses in new construction.
- B. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner's Representative. Impact-type equipment will not be used except where specifically acceptable to the Owner's Representative. Openings in concrete for pipes, conduits, outlet boxes, etc. shall be core drilled to exact size. **Determine location of embedded conduit and reinforcing bars prior to cutting.**
- C. Restoration: All openings shall be restored to "as-new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner's Representative.
- E. Plaster: All plumbing work in area containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. Weakening: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.9 ROOF PENETRATIONS AND FLASHING

- A. Pipe and conduit ducts, pitch pockets, curb bases, and flashing compatible with the roofing installation shall be provided for roof penetrations. Provide framing or other support around all openings through roof as required to preserve the structural integrity of the roof system and make the penetration weathertight.

3.10 EXCAVATING AND BACKFILLING

- A. Perform trenching, excavating, backfilling for plumbing work as set forth below.
- B. Depth of excavation varies with invert of pipe. Excavation to be carried to a depth of at least 6 inches below bottom of pipe elevation. Fill below pipe (6 inches), around pipe, and a minimum of 12 inches above pipe with crushed stone tamped firm and even. Separate topsoil during excavation. Final layer of dirt for exterior installations to be (6 inches minimum) to be topsoil. Backfilling shall be done to exclude use of rock or stone above crushed stone.

3.11 TESTS AND INSPECTIONS

- A. General: The Contractor shall make all tests deemed necessary by the inspection departments of the engineer and the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel and electrical energy for system operational tests following beneficial occupancy by the Owner will be paid for by the Owner.

- B. Other: Additional tests specified hereinafter under the various specification sections shall be made.
- C. Notification: The Owner's Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Architect, Engineer, and/or Owner's Representative.
- D. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner's Representative as specified under "Requirements for Final Acceptance."
- E. Inspections: In general, an inspection by the Owner's Representative shall be required prior to closing up any work and prior to beneficial occupancy or final project completion. The closing up of work includes, but is not limited to, pipe and conduit installations prior to backfilling; mechanical, plumbing electrical, and fire protection work prior to placement of concrete; or closing up walls and overhead mechanical, plumbing, electrical and fire protection work prior to installation of the ceiling.

3.12 CLEANING AND PAINTING

- A. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- B. All other painting shall be accomplished under the Painting Section of Division 9 of the specifications.

3.13 DISCHARGE OF WASTES FROM CONSTRUCTION SITE

- A. The Contractor shall comply with all applicable provisions of local, state, and federal laws regarding the discharge of wastes into sewer and waterways. Special caution shall be exercised to prevent the discharge of wastes which contain oil, tar, asphalt, roofing compound, kerosene, gasoline, paint, mud, cement, lime, or other materials which would degrade the water quality of the receiving water course. The Contractor shall construct and maintain oil interceptors, settling basins, acid neutralization tanks, and/or other effective pollution countermeasures, as required by the Texas Water Quality Board.
- B. On LEED and CHPS projects, contractor is responsible for tracking waste leaving the jobsite. All waste on these projects to be sorted and processed during construction.

END OF SECTION

SECTION 22 0500
BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following basic plumbing materials and methods to complement other Plumbing Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Escutcheons.
 - 4. Dielectric fittings.
 - 5. Dielectric isolation tape
 - 6. Flexible connectors.
 - 7. Mechanical sleeve seals.
 - 8. Nonshrink grout for equipment installations.
 - 9. Field-fabricated metal and wood equipment supports.
 - 10. Installation requirements common to equipment specification sections.
 - 11. Mechanical demolition.
 - 12. Cutting and patching.
 - 13. Touchup painting and finishing.
 - 14. Access Doors
- B. Pipe and pipe fitting materials are specified in Plumbing piping system Sections, if applicable.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. NP: Nylon plastic.
 - 4. PE: Polyethylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. CR: Chlorosulfonated polyethylene synthetic rubber.
 - 2. EPDM: Ethylene propylene diene terpolymer rubber.

1.3 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, access doors, solder/brazing material and mechanical sleeve seals.
- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

- C. Coordination Drawings: Detail major elements, components, and systems of plumbing 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. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 2. Equipment and accessory service connections and support details.
 - 3. Fire-rated wall and floor penetrations.
 - 4. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 5. Access panel and door locations

1.4 QUALITY ASSURANCE

- A. All materials, unless otherwise specified, shall be 51% manufactured in the United States, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. 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.

1.5 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 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.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate plumbing 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 plumbing 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 plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of plumbing 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 plumbing items requiring access are concealed behind finished surfaces.
- 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.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dielectric Tape:
 - a. Holdrite (#272-4).
 - 2. Metal, Flexible Connectors:
 - a. Flexicraft Industries.
 - b. Flex-Weld, Inc.
 - c. Grinnell Corp.; Grinnell Supply Sales Co.
 - d. Mercer Rubber Co.
 - e. Metraflex Co.
 - f. Uniflex, Inc.
 - 3. Rubber, Flexible Connectors:
 - a. General Rubber Corp.
 - b. Mercer Rubber Co.
 - c. Metraflex Co.
 - d. Red Valve Co., Inc.
 - e. Uniflex, Inc.
 - 4. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

- A. Refer to individual Specification piping Sections for pipe and fitting materials and joining methods, if applicable.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Specification piping Sections for special joining materials not listed below, if applicable.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 - 1. ASTM B 32, 95/5 lead-free alloys. Include water –flushable and soluble flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564, medium bodied (bond). Include purple primer according to ASTM F 656.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature, to prevent galvanic action and stop corrosion. Unions in first paragraph below are available in at least NPS 1/2 to NPS 2.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 250 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
 - c. Flanges in first paragraph below are available in at least NPS 1-1/2 to NPS 4.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 175 psig minimum.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.5 DIELECTRIC ISOLATION TAPE

- A. Tape to eliminate dissimilar metal contact: (equal to Holdrite #272-4)
1. White Polyester Felt. Pressure sensitive adhesive rubber base (one side only).
 2. 4" width.

2.6 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
1. 2-Inch NPS and Smaller: Threaded.
 2. 2-1/2-Inch NPS and Larger: Flanged.
 3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- C. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 deg F. Units may be straight or elbow type, unless otherwise indicated.

2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe materials and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.8 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.
 - 5. Sleeve Fasteners: Manufactured, steel clips for securement during pour. Equal to B-line, BD40, BE-5-8 or BE-9-12.
- 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. (split face acceptable for existing piping)
 - a. Finish: Polished chrome-plate.

2.9 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.

2.10 ACCESS DOORS

- A. General: Provide access doors for all serviceable mechanical appurtenances (valves, trap primers, shock arresters, actuators, sensors, etcetera) in inaccessible locations. Such locations include gypsum, brick and CMU ceilings and walls.
- B. Location of panels shall be carefully coordinated with other Exposed Devices as described in earlier paragraphs.
- C. Manufacturers shall be Milcor, Mifab, or approved equal. Unless indicated otherwise, use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.
- D. Minimum construction features include 16-gage frame and door, continuous hinges, cam-style latch and 10"x10" unobstructed opening size.
- E. UL labeled when in fire-rated construction, one and one-half hour rating.
- F. Access doors located outside, in restrooms or in a moisture-laden environment (dressing area, shower area, lockers, etcetera) shall be stainless steel construction.

- G. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. Doors shall be set flush with adjacent finish surfaces. All access doors shall be provided with cylinder locks. All access doors (MEP) shall have one (1) common key.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS AND APPLICATIONS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
- C. All piping to be installed in compliance with current NEC required clearances.
- D. Install manufactured isolation clamps at all dissimilar metal pipe supports. Install dielectric isolation tape (engineer approved) only when a manufactured isolation clamp is not available.
- E. Install piping at indicated slope.
- F. Install components with pressure rating equal to or greater than system operating pressure.
- G. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- H. Install piping free of sags and bends.
- I. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- J. 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.
- K. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- L. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- M. Install fittings for changes in direction and branch connections.
- N. Install couplings according to manufacturer's written instructions.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.
1. Fire-stop all sleeves at floor penetrations of multistory buildings including underfloor penetrations.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- R. 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. CPVC Piping: ASTM D 2846 and ASTM F 493.
 - c. PVC Pressure Piping: ASTM D 2672.
 - d. PVC Nonpressure Piping: ASTM D 2855.
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.

3.2 ESCUTCHEON REQUIREMENTS

- A. Install escutcheons at pipe penetrations of walls, ceilings, and floors in finished areas.
 1. Escutcheons for New Piping:
 - a. Piping exposed through floors and walls in finished areas: One piece, cast brass with polished chrome-plated finish with set screw. Deep escutcheons to be provided where standard depth will not fit.
 - b. Escutcheons shall cover entire hole penetration.
 - c. Escutcheon to be appropriately sized for pipe.
 2. Escutcheons for Existing piping:
 - a. Piping exposed through floors and walls in finished areas: Split plate, cast brass with polished chrome-plated finish with set screw. Deep escutcheons to be provided where standard depth will not fit.
 - b. Escutcheons shall cover entire hole penetration.
 - c. Escutcheon to be appropriately sized for pipe.
 3. 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.

3.3 PIPE SLEEVE INSTALLATION REQUIREMENTS

- A. Pipe sleeves are required at all through wall and floor penetrations.
 1. Sleeves are to be of the following material:

- a. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
 2. Sleeves are required for all through floor and wall penetrations. Sleeves to be set and poured in place (in slab applications), secure all sleeves with fasteners.
 3. Sleeves to extend 2 inches past face of floor or wall. Pipe sleeve in finished areas to be flush with wall or floor for installation of escutcheon.
 4. Install sleeves in new partitions, slabs, and walls as they are built.
 5. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
 6. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
 7. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
 8. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated. Seal annular space with water tight sealant. (equal to NP-1). All sleeves and penetrations to maintain rating of wall / floor. Seal pipe penetrations with fire-stopping materials.
 9. Install sleeve materials according to the following applications:
 - a. Sleeves for Piping Passing through Concrete Floor Slabs: galvanized steel pipe.
 - b. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe sleeves.
 - 1) Extend sleeves 2 inches above finished floor level.
 - 2) For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 10. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel pipe sleeves.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 11. Sleeves for Piping Passing through Concrete Roof Slabs: Reference details.
 12. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel pipe sleeves.
 - b. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 13. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel pipe sleeves.
 14. Mechanical sleeve seals
 - a. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building. Sleeves must be poured in place. Installation of sleeves after wall is constructed is not acceptable.
 - b. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- B. 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.

3.4 DIELECTRIC FITTING INSTALLATION

- A. 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.
- B. 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.

3.5 EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

- A. Install equipment 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 giving right of way to piping installed at required slope.

3.6 PAINTING AND FINISHING

- A. Apply paint to exposed piping according to the following, unless otherwise indicated:
 1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- 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.

3.7 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."

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment (not to be used at pipe supports).

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 DEMOLITION

- 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.

3.10 CUTTING AND PATCHING

- A. Disconnect, demolish, and remove Work specified in Plumbing Sections.
- B. If pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.11 GROUTING

- A. Install nonmetallic, nonshrink, grout for plumbing 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 22 0519
METERS AND GAGES FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following meters and gages for plumbing systems:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs
 - 4. Flow indicators.
 - 5. Temperature and Pressure Test Kit
- B. Related Sections include the following:
 - 1. Specification Section "Domestic Water Piping" for domestic water appurtenances.

1.2 SUBMITTALS

- A. Product Data: For each type of product to be installed.
- B. Operation and Maintenance Data: For all products to be installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Trerice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Black-finished Aluminum, 9 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently baked on scale markings on lens (U.V. protected).
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers:
 - 1. Palmer – Wahl Instruments Inc.
 - 2. Trerice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Manufacturers: Same as manufacturer of thermometer being used.

- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Provide extended neck to accommodate insulation thickness.

2.4 PRESSURE GAGES

- A. Manufacturers:
1. Palmer – Wahl Instruments, Inc.
 2. Trerice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct Mounting, Dial-type Dry or Liquid Filled Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Dry or Liquid-filled type, stainless steel, 4-inch diameter. Weatherproof.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with baked on scale markings.
 6. Pointer: Red or other dark-color metal.
 7. Window: Glass
 8. Ring: Stainless
 9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range of Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
 2. Siphons: NPS 1/4 coil of brass tubing with threaded ends.
 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS (PT PORTS)

- A. Manufacturers:
1. Palmer – Wahl Instruments, Inc.
 2. Trerice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F
- D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

2.6 FLOW INDICATORS

- A. Manufacturers:
1. Dwyer Instruments, Inc. (Series SFI-800 ONLY)
- B. Description: Instrument for installation in piping systems for visual verification of flow. Rated for potable water applications.
- C. Construction: Polysulfone body; with polysulfone sight glass and white polysulfone paddle-wheel indicator, and threaded ends.
- D. Pressure Rating: 150 psig.

- E. Temperature Rating: 212 deg F.
- F. End Connections for NPS 3/4 and Smaller: Threaded.

2.7 TEMPERATURE AND PRESSURE TEST KIT

- A. Test Kit: Furnish (1) test kit containing one pressure gage and adaptor, two (2) thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be 0 to 200 psig.
 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
 4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 1. Inlet and outlet of each storage tank.
 2. Outlet of all domestic water heaters or boilers.
 3. On hot water return line after circulation pump.
 4. At the following locations for mixing valves:
 - a. HW (inlet to valve).
 - b. HWR (inlet to valve).
 - c. Tempered (outlet of valve).
- B. Provide the following temperature ranges for thermometers:
 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 PRESSURE GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve and inlet and outlet of all backflow preventers (Domestic water).
- B. Dry type pressure gages to be used on domestic water systems (inlet and outlets of heaters mixing valves, booster pumps and water softeners).

3.3 FLOW INDICATOR APPLICATION

- A. Install wheel type indicator on outlet side of each domestic pump (recirculation or booster).

3.4 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install $\frac{1}{4}$ " NPT, $\frac{1}{4}$ turn ball-valve and snubber fitting in piping for each pressure gage for fluids.
- E. Install test plugs in tees in piping.
- F. Install flow indicators, in accessible positions for easy viewing, in piping systems.

3.5 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.6 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Bronze ball valves.
 2. Ductile iron Butterfly valves.
 3. Bronze swing check valves.
 4. Iron swing check valves.
 5. Bronze globe valves.
 6. Ductile iron globe valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated and required accessories (chains, extensions, etc.).

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.
 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valve Action: Close rotation shall be clockwise.
- F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation. Extension to be provided by valve manufacturer to match specific product.
 2. Butterfly Valves: With extended neck.
- G. Valve-End Connections:
 1. Flanged: With flanges according to ASME B16.1 for iron valves (with 316 stainless steel bolts).
 2. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel, blowout-proof.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BUTTERFLY VALVES

- A. 200 CWP, Ductile Iron, Lug Style-Flanged Butterfly Valves, potable rated:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum Bronze
 - h. Flange bolts to be 316 stainless steel.

2.4 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

- A. Class 250, Iron Swing Check Valves with Metal Seats, potable rated:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Flange bolts to be 316 stainless steel.

2.6 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.7 DUCTILE IRON GLOBE VALVES

- A. Class 150, Ductile Iron Globe Valves, potable rated:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A395, ductile iron.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: PTFE.
 - g. Flange bolts to be 316 stainless steel.

2.8 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Install valves with brass short nipples and brass unions at downstream side (outlet) of ball and globe valves (NPS 2 and smaller).**
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem and handle movement. Valve handle to have ample clearance to be fully exercised without interference (full open and full closed) with no modifications to handle.
- F. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 120 inches above finished floor. Extend chains to 96 inches above finished floor.
- G. All valves NPS 3 and smaller shall be installed within 120 inches above finished floor.
- H. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - I. For all valves on insulated piping, provide insulated stem extension.
 - J. Install shutoff valves immediately upstream of each dielectric fitting.
 - K. Provide and install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
 - L. Provide and install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Drain Valves (At low points in water mains, risers, and branches): Ball valves

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.
- B. Perform the following adjustments before operation:
 - 1. Open shutoff valves to fully open position.
 - 2. Remove and clean strainer screens. Close drain valves and replace drain plugs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. Valve applications, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Flange (lug) type.
 - 3. Throttling Service: Globe valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2-1/2 and larger: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 and larger: Flanged ends.

3.5 VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Ball Valves: Two piece, full port, bronze with stainless-steel trim; **with brass short nipple and brass union connection at downstream side (outlet).**
 2. Bronze Swing Check Valves.
 3. Bronze Globe Valves: **With brass short nipple and brass union connection at downstream side (outlet).**
- B. Pipe NPS 2-1/2 and Larger:
 1. Ductile Iron, Butterfly Valves.
 2. Iron Swing Check Valves.
 3. Ductile Iron Globe Valves.

END OF SECTION

SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment.
1. Steel pipe hangers, supports and riser clamps
 2. Thermal-hanger shield inserts and saddles.
 3. Fastener systems.
 4. Pipe positioning systems.
 5. Equipment supports.
- B. Related Sections include the following:
1. All plumbing specification sections.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Weight loading for supports and hangers shall not exceed manufacturers recommended tolerances and limits.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts and saddles.
 3. Fastener systems.
 4. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-steel."
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1. "Structural Welding Code-Steel".

PART 2 – PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be 51% manufactured in the United States, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.

2.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 METAL COATING REQUIREMENTS:

- A. All metal products shall have the following coatings:
 1. Wet/damp areas: hot dipped galvanized.
 2. Dry or conditioned areas: pre-galvanized.

2.4 STEEL PIPE HANGERS, SUPPORTS AND RISER CLAMPS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hangers and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.
 3. Grinnell Corp.
- C. Galvanized, Metallic Coatings: Pre-galvanized (minimum thickness of 0.5 mils) or hot dipped (1.4 to 3.9 thickness).
- D. Nonmetallic Coatings: Plastic coating, jacket or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.
- F. Epoxy Coatings: Copper colored epoxy coating on carbon steel hangers and supports for use on noninsulated copper piping only.
- G. Channel, rod and securement hardware:
 1. Channel: 12-ga.
 2. Rod: Sized as scheduled.
 3. Hardware (clamps, bolts, washers, etc): coating per area indication.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert with a sheet metal shield.
- B. Manufacturers:
 1. B-line
 2. ERICO / Michigan Hanger CO
 3. Grinnell Corp
 4. Buckaroos
- C. Insulation –Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier. Wood inserts are not acceptable.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type 1 calcium silicate or ASTM C 552, Type II cellular glass.

- E. Insulation-Insert Material for Cold and Hot Piping, up to 3" diameter: Molded fiberglass block, 20 lbs/ft³ density, thermal conductivity of 0.30.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. Powers Fasteners.
- B. Concrete Insert: electroplated steel finish, for embedding in concrete. Steel insert nut for rod attachment.
1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. Powers Fasteners.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
1. C&S Mfg. Corp.
 2. HOLDRITE Corp.; Hubbard Enterprises.
 3. Samco Stamping Inc.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes and bars. Galvanized only. Painted steel not acceptable.

PART 3 - EXECUTION

3.1 HANGERS AND SUPPORTS APPLICATIONS AND INSTALLATION

- A. Specific hanger and support requirements are specified in Hanger Application Schedule below.
- B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps and attachments as required to properly support piping form building structure; attaching to metal roof decks is not permissible.
- C. Use hangers and supports with galvanized, metallic coatings for piping. Field applied finish is not acceptable.
- D. Use nonmetallic plastic or epoxy coating, jacket or liner coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Rod to be installed plumb. Bending rod is not acceptable. Provide and install required attachments.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Heavy Duty Steel Clevis Hangers: For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Strut System Clamps: For attachment of piping to channel. NPS 1/2 to NPS 2.

- a. Noninsulated copper piping to have dielectric insert. (dielectric tape not acceptable).
 3. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 4. Install hangers for piping with the following maximum horizontal spacing and minimum rod diameters (hangers shall be spaced to prevent sagging):
 - a. NPS 2 and Smaller: 60 inches with 3/8-inch rod.
 - b. NPS 2-1/2 to 5: 60 inches with 1/2-inch rod.
 - c. NPS 6 to 8: 60 inches with 3/4-inch rod.
- H. Vertical-Piping Riser Clamps: Unless otherwise indicated and except as specified in piping system Section, install the following types:
1. Required at all risers from under-floor or through floors from floor below. Risers clamps to be installed every 10 ft max. Coordinate installation with sleeves.
- I. Building and Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Wide Jaw C-Clamps: For structural shapes, with retaining clip.
 2. NPS 2 and smaller: mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 3. NPS 2 ½ and larger: Concrete spot insert. Install building attachments within concrete slabs. Install additional attachments at concentrate loads, including valves, flanges and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Insulation Piping Installation:
1. Provide manufacture galvanized metal shield with locking tabs or securement band.
 2. For Trapeze or Clamped Systems: Thermal insert and shield shall cover entire circumference of pipe.
 3. For Clevis or Band Hangers: Thermal insert and shield shall cover lower 180 degrees of pipe.
 4. Thermal Insert Length: Extend 4 inches beyond sheet metal shield for piping operating below ambient air temperature.
- K. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures; minimum three (3) for vertical pipe sections.
- L. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer Specification Section "Plumbing Fixtures" for plumbing fixtures.
- M. Install hangers and supports complete with necessary inserts, bolts, rods, nuts washers and other accessories.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stressed from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

3.2 EQUIPMENT SUPPORTS

- A. Manufacturer's structural-steel system to suspend equipment from structure overhead or to support equipment above floor.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 inch.

3.4 PAINTING

- A. Repair Galvanized Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Equipment labels.
 2. Warning signs and labels
 3. Pipe labels.
 4. Valve tags.
 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/8 inch** thick, and having predrilled holes for attachment hardware.
 2. Letter Color: **White**.
 3. Background Color: **Black**.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel **rivets or self-tapping screws**.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 by 11 inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section

number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-Steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engrave with 1/4 inch letters piping system abbreviation and 1/2 inch numbers.
- B. Valve Schedules: For each piping system, on 8-1/2 by 11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of a valve (room or space), normal-operating position (open, closed or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance date.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, or plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", OR "DO NOT OPERATE".
 - 4. Color: yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces or substances that could impair band of identification devices, including dirt, oil, grease, release agents and incompatible primers, paints and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Specification Section "Interior Painting".
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings and inaccessible enclosures.
 4. At access doors, manholes and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 1. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 2. Domestic Hot Water Piping:
 - a. Background Color: Red.
 - b. Letter Color: White.
 3. Sanitary Waste and Vent and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and controls devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches round.
 - b. Hot Water: 1-1/2 inches square.
 2. Valve-Tag Color:
 - a. Cold Water: Blue.
 - b. Hot Water: Orange.
 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 0716
PLUMBING INSULATION

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing insulation for equipment and pipe, including the following:
1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible Elastomeric.
 - c. Mineral fiber.
 - d. Phenolic
 2. Adhesives.
 3. Mastics.
 4. Sealants.
 5. Factory-applied jackets.
 6. Field-applied tape.
 7. Field-applied jackets.
 8. Securements.
- B. Related Sections include the following:
1. Specification Section "Hangers and Supports" for high-density inserts at hangers; **wood inserts at hangers are not acceptable.**
 2. Specification Section "Special Conditions for All Plumbing Work".
 3. Specification Section "Basic Plumbing Materials and Methods".
- C. Not all items listed within this specification are used. Use only items applicable per application schedule.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. CONCEALED: Covered or concealed by a ceiling (gypsum or lay-in acoustical tile) or wall.
- C. EXPOSED: Open to view; not concealed by a ceiling or wall of any sort.
- D. FSK: Foil, scrim, kraft paper.
- E. UNDERFLOOR: Accessible crawl space beneath lowest floor level (considered "outdoors").

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any). Provide submittal data on all products to be used.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. All products to be stored in a dry location, protected from the elements. All damaged insulation to be replaced.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and high-density insulation inserts and shields specified in Specification Section "Hangers and Supports." Coordinate with drawing details where applicable; wood inserts at hangers are not acceptable.
- B. Coordinate clearance requirements with piping Installer for piping insulation application, and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
- C. Insulation not to be installed until building is dried in.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Phenolic:
 1. Products
 - a. Insul-phen
 2. 100% CFC-free, HCFC-free, and halogen-free, closed cell rigid phenolic foam insulation.
 3. Minimal thermal conductivity @ 75° F.
 - a. Green, 2.5 lb/ft³. 0.15 (Btu.in/hr.ft².F)
 - b. Pink, 5.0 lb/ft³. 0.21 (Btu.in/hr.ft². F)
- G. Cellular Glass:

1. Products:
 - a. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 7. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Minimal thermal conductivity at 75° F of 0.29 (Btu.in/hr.ft². F) (R-value of 10.34@ 3 inches thickness). Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- H. Flexible Elastomeric:
 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacel LLC; AP Armaflex.
 2. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 3. Minimal thermal conductivity at 75° F of 0.25 (Btu.in/hr.ft². F.)
- I. Mineral-Fiber Blanket Insulation:
 1. Products:
 - a. Johns Manville; Microlite.
 - b. Knauf Insulation; Duct Wrap
 - c. Owens-Corning; All-Service Duct Wrap.
 2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied jackets" Article.
- J. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000° Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- K. Fire Rated Wrap
 1. Manufacturers:
 - a. 3M
 - b. Specialty Products and Insulation Co.
 2. Insulation Materials: Fire rated fiber wrap insulation: 1-1/2 inch thick low bio-persistent Alka-line Earth Silicate fiber with melting point at 2200 degrees F. jacket shall be foil faced (one side) Kraft fiber paper with a concealed reinforcing scrim. (FSK) One hour rating with 1-layer of wrap, 3 inches to combustibles. Two hour rating with 2 layers of wrap, 0 inch to combustibles.
 3. Accessories and Attachments:
 - a. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq.yd.
 - 1) Tape Width: 4 inches.
 - b. Bands: 3/4 inch wide, in one of the following materials compatible with jacket.
 - 1) Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.

- c. Insulation Anchor Pings and Speed Washers: Galvanized steel plate, pin and washer manufactured for attachment to duct by weld. Pin length sufficient for insulation thickness indicated.
 - d. Vapor Retarders: Mastics: Materials recommended by insulation material manufacturers that are compatible with insulation materials, jackets, and substrates.
4. Secured per manufacturer's requirements and AHJ.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).
- B. Cellular-Glass, Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products:
 - a. Foamglas: Pittseal 444N or equal
- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products:
 - a. K-Flex: 720 LVOC or equal
- D. Phenolic: Water based adhesive with a service temp of minus 20°F to 700°F.
 - 1. Products:
 - a. Foster 97-15
- E. Metal Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products:
 - a. Design Polymerics, DP2502 (or approved equal).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).
- B. Vapor-Barrier Mastic: Water based; suitable for outdoor use on below ambient services, or indoor vapor barrier use.
 - 1. Products:
 - a. Childers Products, Division of ITW; CP-35.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.09 perm at 55-mils film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 190 deg F.
 - 4. Solids Content: ASTM D 1644, 60 percent by volume and 73 percent by weight.
 - 5. Color: White.
 - 6. VOC: 36 g/l.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products:
 - a. Pittsburgh Corning Corporation; Pittseal 444N.
 - 2. Joint Sealant for Phenolic Products
 - a. Foster 95-50
- B. Metal Jacket:
 - 1. Products:
 - a. Foster 95-44 or equal.
 - b. Childers Products, Division of ITW; CP-76.
- C. Mineral Fiber:

1. Design Polymerics DP 2502.
 2. Childers Products, Division of ITW; CP-35.
- D. PVC Jacket:
1. Childers Products, Division of ITW; CP-35.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 25/50 ASTM-F 84, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products:
 - a. Johns Manville; Zeston.
 - b. Proto PVC Corporation; LoSmoke.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White:
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Width: 3 inches.
 2. Thickness: 14.0 mils.
 3. Adhesion: 73 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 55 lbf/inch in width.
 6. Color: White
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Width: 3 inches.
 2. Thickness: 13 mils.

3. Adhesion: 73 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. Color: Silver

2.9 SECUREMENTS

- A. Bands:
 1. Products:
 - a. Childers Products; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel.

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.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application. For Stainless Steel; apply a corrosion coating to insulated surfaces with an epoxy primer and an epoxy finish 5 mils thick.
- B. Verify and coordinate insulation installation with the systems and trades installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, and pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install high-density inserts at hanger locations prior to insulating; wood or block inserts are not acceptable
- F. Do not weld brackets, clips, pins or other attachment devices to piping, fittings, tanks, coils, equipment, vessel, and specialties.
- G. Keep insulation materials clean and dry before, during application, and finishing.
- H. Install insulation with tight longitudinal seams and end joints, with least number of joints practical.

- I. Install insulation so that material is not over compressed.
- J. Seal all joints, and seams, including penetrations in insulation, at supports, and other projections with insulation of same material overlapped by 2". Secure strips with outward clinching staples along both edges of strip, (spaced 1 inch on center) and seal entire joint or seam with mastic.
- K. Do not insulate, conceal, or enclose pipe hangers, channel and steel supports, etc. not directly fasten to duct.
- L. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses. Do not water down products unless directed by manufacturer. Use clean potable demineralized water when required.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair all damage insulation prior to concealment as noted above.
- P. Do not insulation or conceal vibration-control devices, labels, stamps, nameplates, data plates, manholes, cleanouts, etc. require for maintenances.
- Q. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarded integrity, unless otherwise indicated.
- R. Insulate pipe elbows, tees, valves, strainers, flanges, etc., using preformed fitting insulation, mitered fittings or oversized preformed pipe insulation made from same material thickness and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, voids, and irregular surfaces with insulating mastic finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. Provide a removable reusable insulation cover; design that maintains vapor barrier. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
- S. Cover segmented insulated surfaces with a layer of finishing mastic prior to jacket installation.
- T. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Secure PVC covers to adjoining insulation facing using staples and ASJ tape. Seal PVC fitting covers with mastic.
- U. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating adhesive and finish with finishing mastic. All connections are to be accessible.
- V. Install removable insulation segment and covers at flanges, valves, controls, unions, equipment access doors, manholes, hand holes, and other elements that require frequent removal for service and inspection. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.4 PENETRATIONS

- A. Install insulation continuously through all walls, floors, and partitions penetrations and sleeves.
- B. Extend jacket of outdoor installation into wall and roof jacks by 2 inches. Seal jacket to roof flashing with approved flashing sealant.
- C. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with approved flashing sealant.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Preformed Pipe Insulation Installation on Pipe, Fittings, Valves, Flanges, Tanks, Elbows, and Appurtenances for Cellular- Glass, Mineral- Fiber, Flexible Elastomeric, and Phenolic insulations:
1. Install insulation in a manner that secures material to system being insulated with staples, tape and mastic.
 2. When insulation with preformed pipe insulation, seal all longitudinal seams, end joints, and protrusions with manufacturers recommended tape matching jacket, vapor-barrier mastic, joint sealant, and adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 3. Secure fittings, jacket, cover, etc. with tape matching jacket and secure with outward clinched staples 1 inch on center. Apply vapor-barrier mastic over staples.
 4. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.
 5. Pipe hangers are not to be concealed in insulation.
 6. Seal all exposed insulation ends with mastic.
 7. Seal all mitered joints prior to installing covers with vapor-barrier mastic.
 8. Install preformed pipe insulation to outer diameter of pipe flange.
 9. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 10. Fill voids between inner circumference of valves, flange, elbows, and bolts insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 11. Install preformed sections of same material insulation when available. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Install PVC cover over fitting or mitered section.
 12. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.

3.6 GENERAL BLANKET INSULATION INSTALLATION (IN ADDITION TO COMMON REQUIREMENTS)

- A. Blanket Insulation Installation on Pipes, Drains, Tanks, Vessels, Elbows, and Appurtenances:
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for a minimum of 50 percent coverage of insulated surface and 100 percent coverage of equipment, tanks, etc.; to secure insulation to surfaces. Apply adhesive to entire circumference of all surfaces; including fittings and transitions.
 2. Install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 3/4-inch outward-clinching staples, 1 inch on center. Coat all seams/joints with mastic.
 3. Repair punctures, tears, penetrations and protrusions with 6-inch-wide strips of same material used to insulate duct. Seal all seams with staples, cover with mastic and cover with embedded fiberglass reinforced mesh, cover mesh with finish coat of mastic.
 4. Do not conceal hangers beneath/under insulation.
 5. Insulation termination: Butt insulation up to termination point. Apply mastic no less than 3" overlap on insulation, and 3" on metal surface.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Apply two continuous beads of sealant to seams and joints, one

bead under lap and the finish bead along seam and joint edge. Secure metal jacket with stainless-steel bands 12 inches on center and at end joints.

3.8 FINISHES

- A. Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material:
Paint jacket with paint system identified below and as specified in painting Sections (if applicable).
 - 1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect insulated pipe, and equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two (3) location(s) for each system.
 - 2. All insulation applications will be considered defective work if sample inspection reveals noncompliance with requirements.
 - 3. Remove all defective work and install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures as needed.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Fire-suppression piping.
 - 2. Drainage piping located in crawl spaces.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
 - 1. Concealed Locations:
 - a. 0 through 1-1/4" Pipe Size: Insulation shall be any of the following:
 - 1) Mineral Fiber Preformed: Type 1: 1-inch thick.
 - 2) Phenolic (2.5 lb/ft³), 1-inch thick.
 - 3) Cellular Glass: 1-1/2 inches thick.
 - b. 1-1/2" and Larger Pipe Size: Insulation shall be any of the following:
 - 4) Mineral Fiber Preformed: Type 1: 1-1/2"-inch thick.
 - 5) Phenolic (2.5 lb/ft³), 1-1/2"-inch thick.
 - 6) Cellular Glass: 1-1/2 inches thick.
 - 2. Exposed Locations: (including inside mechanical rooms):
 - a. 0 through 1-1/4" Pipe Size: Insulation shall be any of the following:
 - 1) Phenolic (3.5 lb/ft³), 1-inch thick.
 - 2) Cellular Glass: 1-1/2 inches thick.
 - 3) Mineral Fiber Preformed: Type 1: 1-inch thick.
 - b. 1-1/2" and Larger Pipe Size: Insulation shall be any of the following:
 - 4) Phenolic (3.5 lb/ft³), 1-1/2-inch thick.
 - 5) Cellular Glass: 1-1/2 inches thick.
 - 6) Mineral Fiber Preformed: Type 1: 1-1/2"-inch thick.

- B. Condensate, Equipment Drain, Floor Drains, Traps and Waste Water below 60 Deg F:

1. All PVC Piping exposed to and in a Return Air Plenum: Insulation shall be any of the following:
 - a. Fire rated wrap.
2. All Other Pipe: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Phenolic (2.5 lb/ft³): 1-1/2 inches thick.
- C. Horizontal Storm Water Piping (continuous from roof drain body to first vertical drop):
 1. All PVC Piping exposed to and in a Return Air Plenum: Insulation shall be any of the following:
 - a. Fire rated wrap.
 2. All Other Pipe: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Phenolic (2.5 lb/ft³): 1-1/2 inches thick.
 - c. Mineral Fiber, Preformed, Type 1: 1-inch thick.
- D. Roof Drain Body:
 1. PVC Roof Drain Body exposed to and in a Return Air Plenum: Insulation shall be any of the following:
 - a. Fire rated wrap.
 2. All Other Roof Drain Bodies: Insulation shall be any of the following:
 - a. Mineral-Fiber Blanket Insulation: 1-1/2 inch thick.
- E. Sanitary Waste & Vent; Domestic Water piping:
 1. All PVC Piping exposed to and in a Return Air Plenum: Insulation shall be any of the following:
 - a. Fire rated wrap.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE (ATTIC AND CRAWL SPACE INCLUDED)

- A. Domestic Cold, Hot and Recirculated Hot Water:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Pre-insulated Pipe: 1-1/2" thick (underfloor, outdoors and buried)
 - b. Cellular Glass: 2 inches thick (outdoors, not acceptable indoors)
 - c. Phenolic (5 lb/ft³): 2 inches thick (outdoors, not acceptable indoors)
 - d. Mineral Fiber Preformed, Type 1: 1-1/2 inch thick (uninsulated Attic space)
- B. Condensate, Equipment Drain, Floor Drains, Traps and Waste Water below 60 Deg. F:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick
 - b. Phenolic (5 lb/ft³): 1-1/2 inches thick
 2. Insulation shall be continuous until the connection to the sanitary system.
- C. Fire Protection:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick
 - b. Phenolic (5 lb/ft³): 1-1/2 inches thick

3.13 INSIDE EXTERIOR WALL PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot and Recirculated Hot Water:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick
 - b. Phenolic (2.5 lb/ft³): 1 inch thick
 - c. Mineral Fiber Preformed, Type 1: 1 inch thick, coat entire ASJ jacket with vapor mastic
- B. Condensate, Equipment Drain, Floor Drains, Traps and Waste Water below 60 Deg. F:
 1. All Pipe Sizes: Insulation shall be any of the following:

- a. Cellular Glass: 1-1/2 inches thick
 - b. Phenolic (2.5 lb/ft³): 1-1/2 inches thick
- C. Fire Protection:
- 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Cellular Glass: 1-1/2 inches thick
 - b. Phenolic (2.5 lb/ft³): 1-1/2 inches thick

3.14 FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping exposed in finish interior areas, outdoors, in underfloor, mechanical rooms:
 - 1. Aluminum, Stucco Embossed: 0.016 inch thick.
- C. Indoor piping fitting or elbows:
 - 1. PVC: (0.015 inch thick).

END OF SECTION

SECTION 22 0800
PLUMBING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 22 responsibilities in the commissioning process which are being directed by the CxA. Other plumbing systems testing may be required by other specification sections and under the direction of the PM.
- B. The list of commissioned equipment and systems is found in Section 01 9100.
- C. Commissioning requires the participation of Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 9100. Division 22 shall be familiar with all parts of Section 01 9100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- D. Related Sections
 - 1. Section "Sustainable Design Requirements" for LEED Certification
 - 2. Section "Building Systems Commissioning"
 - 3. Section "Special Conditions for All Plumbing Work"

1.2 RESPONSIBILITIES

- A. Plumbing Contractors. The commissioning responsibilities applicable to the plumbing contractor are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

- 1. Include the commissioning cost of the electrical contractor in the contract price.
- 2. In each purchase order or subcontract written, include requirements for submittal data, O&M data, and training.
- 3. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
- 4. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.
- 5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
 - a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
- 6. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
- 7. Provide limited assistance to the CxA in preparing a full start-up and initial checkout plan using manufacturer's start-up procedures. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review. Refer to Section 01 9100 for further details on start-up plan preparation.
- 8. Perform all completed start-up and system operational checkout procedures in the presence of the CxA.
- 9. Address current A/E punch list items before functional testing.
- 10. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the

agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.

11. Perform functional performance testing under the direction of the CxA for specified equipment in Section 01 9100. Assist the CxA in interpreting the monitoring data, as necessary.
12. Correct deficiencies (difference between specified and observed performance) as interpreted by the CxA, PM and A/E and retest the equipment.
13. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
14. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builds for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builds for contractor-generated coordination drawings.
15. Provide training of the Owner's operating personnel as specified.
16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Correct deficiencies and make necessary adjustments to O&M manual and as-built drawings for applicable issues identified in any seasonal testing.

1.3 RELATED WORK

- A. Refer to Section 01 9100, for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 01 9100 for systems to be commissioned.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Division 22 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Division 22 shall provide submittal documentation relative to commissioning as required in this Section Part 1 and Section 01 9100.

3.2 STARTUP

- A. The plumbing contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 9100. Division 22 has start-up responsibility and is required 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 commissioning agent or Owner.
- B. Functional testing is intended to begin after completion of the Field Installation Verifications and Operational Performance Tests. Functional testing shall not proceed prior to the completion of systems or sub-systems.

3.3 FUNCTIONAL PERFORMANCE TESTS

- A. Refer to Section 01 9100 for a list of systems to be commissioned and for a description of the process.

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 01 9100 for specific details on non-conformance issues relating to pre-functional checklists and tests.

3.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 22 shall compile and prepare documentation for all equipment and systems covered in Division 22 and deliver to the Contractor for inclusion in the O&M manuals, according to this section and Division 1 Section "Operation and Maintenance Data," prior to the training of owner personnel.
- B. The CxA shall receive a copy of the O&M manuals for review.
- C. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CxA. Refer to Division 1 Section "Operation and Maintenance Data" for details.

3.6 TRAINING OF OWNER PERSONNEL

- A. The Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 9100 for additional details.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 01 9100 for additional details.
- C. Plumbing Contractor. The plumbing contractor shall have the following training responsibilities:
 1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 9100.
 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shutdown, etc.
 4. 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.
 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment.
 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. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
 8. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 9. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

3.7 DEFERRED TESTING

- A. Refer to Section 01 9100 for requirements of deferred testing.

3.8 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 01 9100.

END OF SECTION

SECTION 22 1116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 2. Encasement for piping.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 1. Piping and fittings.B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency. Origin of product to be domestic. No imported product will be acceptable.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L or K water tube, drawn temper.
 1. Copper Pressure Fittings: ASME B16.18, cast copper-alloy or ASME B16.22, wrought-copper, solder fittings.

B. Soft Copper Tube: ASTM B 88, Type L or K water tube, annealed temper.
 1. Copper Pressure Fittings: ASME B16.18, cast copper-alloy or ASME B16.22, wrought-copper, solder fittings.

C. Copper Pipe, Pre-insulated:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insul-Pipe Systems, Inc.
 - b. Insul-tek
 - c. Thermal Pipe Systems, Inc.

- d. Thermacor Process L.P.
2. Description: Factory pre-insulated double-wall pipe system.
3. Carrier Pipe: Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
4. Wrought-Copper Fittings: ASME B16.22.
5. Pipe Insulation: Foamed-in-place polyurethane, 90% closed cell, poured in place, "K" = 0.14 per inch @ 75 degrees F, with a density of not less than 2.5 lbs. per cubic foot. Insulation shall be completely encased within a seamless jacket.
 - a. Insulation at each end of each length of pipe shall be protected with an end seal bonded both to the carrier pipe and the outer jacket. Piping cuts made in the field must be provided with end-seals equal to factory type.
 - b. Insulation thickness, minimum: 1.12-inches for NPS 2 and smaller; 1.67-inches for NPS 2-1/2; 1.42-inches for NPS 3; 1.93-inches for NPS 4; and 1.93-inches for NPS 6.
6. Jacket: PVC; ASTM D-1784, Class 12454-B, of not less than .060 inches thick and able to withstand H-20 highway loading.
7. Fitting insulation: Coupling joints on straight runs shall be field wrapped with a mold/jacket of roll PVC, sealed with self seal tape and filled with field mixed pour polyurethane foam. Fittings shall be field insulated using a field mixed polyurethane poured between the fitting and a PVC fitting cover supplied by the manufacturer that is sealed with self seal tape. Vapor barrier jacketing material for fittings and joints shall be of the same material as the pipe jacketing. Installation shall be as per manufacturer's instructions.

2.3 NIPPLES

- A. Brass Nipple: ASTM B687-88
 1. Threads: NPT (Federal Services Handbook H-28)
 2. Potable use.

2.4 UNIONS

- A. Factory-fabricated, brass or bronze union assembly, for 150-psig minimum working pressure at 180 deg F, ASTM B687-88
- B. End Connections: Solder-joint copper alloy and / or threaded ferrous.
- C. Potable use.

2.5 FLANGES

- A. Factory-fabricated, bronze union assembly, for 150-psig minimum working pressure at 180 deg F, ASME B16.24, Class 150.
- B. End Connections: Solder-joint copper alloy and / or threaded ferrous.
- C. Potable use.
- D. All bolts to be 316 stainless steel (Class 150).

2.6 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, 95/5 lead-free alloys. Include water-flushable and soluble flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.7 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.

- B. Form: Tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black or blue.

2.8 TRANSITION FITTINGS

- A. General Requirements:
 1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 2. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.
- E. Plastic-to-Metal Transition Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 2. Description: CPVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- D. Provide and install shutoff valve, strainer, pressure reducing valve, hose-end drain valve, pressure gage, and test tee with valve, inside the building at each domestic water service

- entrance. Comply with requirements in Section "Meters and Gages" for pressure gages and Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install domestic water piping level and plumb.
 - F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
 - G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
 - H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
 - I. Install piping adjacent to equipment and specialties to allow service and maintenance.
 - J. Install piping to permit valve servicing.
 - K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
 - L. Install piping free of sags and bends.
 - M. Install fittings for changes in direction and branch connections.
 - N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty valves.
 - O. All pipe nipples to be brass.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join and prepare/clean copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- G. All piping is to be cleaned prior to concealment.

3.3 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 1. NPS 2 and Smaller: Fitting-type coupling.
 2. NPS 2-1/2 and Larger: mechanical joint-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition unions.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.

- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to all equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by engineer and authorities having jurisdiction
 - 2. During installation, notify engineer and authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of engineer and authority having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for engineer and authority having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If the engineer or authority having jurisdiction finds that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by engineer and authority having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 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 for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.7 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions to be provided and installed at all equipment connections and appurtenances.
- C. Under-building-slab, domestic water, building service and distribution piping, NPS 2 and smaller, shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; (continuous, no joints under slab.)
- D. Under-building-slab, domestic water, building-service piping, NPS 2-1/2 and larger, shall be the following (see detail for additional requirements):
 1. Hard copper tube, ASTM B 88, Type K; wrought- copper brazed-joint fittings and joints.
 2. Mechanical-joint, ductile iron pipe; standard-pattern mechanical-joint fittings; and mechanical joints.
- E. Aboveground domestic water piping, all sizes, shall be the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- F. Underfloor domestic water piping shall be the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 2. Pre-insulated copper pipe. (Hot and Recirculated water only)

END OF SECTION

SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Balancing valves.
 5. Temperature-actuated water mixing valves.
 6. Strainers.
 7. Hose bibbs.
 8. Wall hydrants.
 9. Water hammer arresters (shock arrestors).
 10. Trap-seal primer valves.
 11. Flexible connectors.
 12. Drain Valves.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.

- e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Mechanical areas: Rough bronze. Finished areas: Chrome
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group.
 2. Standard: ASSE 1011.
 3. Body: Bronze, non-removable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Rough bronze.

2.2 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Strainer: Y-pattern with threaded ends on inlet of NPS 2 and smaller.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- C. Pressure Type Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1052.
 3. Operation: Up to 10-foot head of water back pressure.
 4. Inlet Size: NPS 1/2 or NPS 3/4.
 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.

2.3 WATER PRESSURE-REDUCING VALVES

- A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1003.
 3. Pressure Rating: Initial working pressure of 150 psig.
 4. Size: Service line size.
 5. Design Outlet Pressure Setting: 70 psig.
 6. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. Taco, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Type: Y-pattern globe valve with two readout ports and memory setting indicator.
 3. Body: Bronze.
 4. Size: Same as connected piping, but not larger than NPS 2.
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.
 4. Type: Thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
- B. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
 2. Description: Factory-fabricated, thermostatically controlled, water-mixing-valve assembly in two or three-valve parallel arrangement.
 3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 5. Small-Flow Parallel: Thermostatic water mixing valve.
 6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
 7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
 9. Cabinet (where indicated): Factory-fabricated, stainless steel, for recessed or surface mounting (per drawing indication) and with hinged, stainless-steel door.

10. Performance characteristics and other requirements: Refer to drawings.
- C. Individual-Fixture, Water Tempering Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 4. Body: Bronze body with corrosion-resistant interior components.
 5. Temperature Control: Adjustable.
 6. Inlets and Outlet: Threaded.
 7. Finish: Rough or chrome-plated bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 6. Drain: Factory-installed, hose-end drain valve.

2.7 HOSE BIBBS

- A. Hose Bibbs:
 1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body Material: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: NPS 3/4 threaded -joint inlet.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 6. Pressure Rating: 125 psig.
 7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 8. Finish for Equipment Rooms: Rough bronze, or chrome plated.
 9. Finish for Service Areas: Rough bronze.
 10. Finish for Finished Rooms: Chrome plated.
 11. Operation for Equipment Rooms: Metal wheel handle or operating key.
 12. Operation for Service Areas: Metal wheel handle.
 13. Operation for Finished Rooms: Operating key.
 14. Include operating key with each operating-key hose babb.
 15. Include integral wall flange with each chrome plated hose babb.
 16. Other requirements: Refer drawing schedules and provide equivalency to model and manufacturer listed.

2.8 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.21.3M for self-draining wall hydrants.
 3. Pressure Rating: 125 psig.
 4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 5. Inlet: NPS 3/4 or NPS 1.
 6. Other requirements: Refer drawing schedules and provide equivalency to model and manufacturer listed.
- B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.21.3M for self-draining wall hydrants.
 3. Pressure Rating: 125 psig.
 4. Casings and Operating Rods: Of length required to match wall thickness. Include wall clamps.
 5. Inlets: NPS 3/4 or NPS 1.
 6. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 and with garden-hose thread complying with ASME B1.20.7 on outlet.
 7. Other requirements: Refer drawing schedules and provide equivalency to model and manufacturer listed.

2.9 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 600-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Bronze.
 5. Ball: Stainless steel.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS (SHOCK ARRESTORS)

- A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. PPP Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Drainage Products Inc.

- f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES (TRAP PRIMERS)

- A. Supply-Type, Trap-Seal Primer Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Drainage-Type, Flushometer, Trap-Seal Primer Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Zurn Plumbing Products Group; Commercial Brass Operation.
 2. Standard: Vacuum breaker trap primer fitting that diverts a small amount of water with each flush; NPS 3/8 minimum, trap makeup connection.
 3. Size: NPS 1-1/2 minimum.
 4. Material: Chrome-plated, cast brass.
 5. Accessories: Chrome-plated wall flange, fittings and elbow.
- C. Drainage-Type, Lavatory, Trap-Seal Primer Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 3. Size: NPS 1-1/4 minimum.
 4. Material: Chrome-plated, cast brass.

2.12 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings "Plumbing Fixture Schedule" or a comparable product by one of the following:
 - a. PPP Inc.
 2. Standard: ASSE 1044,
 3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
 4. Cabinet: Recessed or Surface-mounting (per drawing indication) steel box with stainless-steel cover.
 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 6. Vacuum Breaker: ASSE 1001.
 7. Number Outlets: Refer to drawings.

8. Size Outlets: NPS 1/2.

2.13 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flex-Hose Co., Inc.
 2. Metraflex, Inc.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Install backflow preventers at 42-in above finished floor in an accessible location, preferably on a wall with galvanized steel channel and pipe strap support.
 4. Do not install bypass piping around backflow preventers.
 5. Provide and install threaded brass plugs for all test ports.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-pressure-reducing valves downstream from shutoff valves.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install water mixing valves at 42-in above finished floor in an accessible location, preferably on a wall with galvanized steel channel and pipe strap support.
 2. Install thermometers and water regulators if specified.
 3. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install water hammer arresters in water piping according to PDI-WH 201 and applicable drawing details.
- I. Install trap-seal primer valves without dedicated isolation valves; supply from nearest branch serving an occupant-use plumbing fixture. System style trap primer to have isolation valve.
- J. Install supply- and drainage-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow. Install unit at a minimum of 36" AFF.

- L. Provide and install a calibrated balancing valve in each hot-water circulation return loop.
Verify that system flowrate is set and matches drawing requirements.

3.2 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge manifold connections to each domestic water booster pump.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test and certify each backflow assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- D. Open throttling valves to proper setting.
- E. Verify (by instrument flow testing) that auto-flow balancing valves in hot-water-circulation return piping are flowing specified gpm.
- F. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
- G. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
- H. Check plumbing specialties and verify proper settings, adjustments, and operation.

END OF SECTION

SECTION 22 1316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 1. Pipe, tube, and fittings.
 2. Special pipe fittings.

1.3 DEFINITION

- A. Condensate Piping: Drainage piping that indirectly conveys clear-water condensate from air conditioning and refrigeration equipment to the sanitary drainage system.
- B. Indirect Drainage Piping: Piping that conveys waste water from mechanical equipment, including cooling towers, evaporative coolers, evaporative condensers, chilled-water systems, etcetera, to the sanitary drainage system.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. LLDPE: Linear, low-density polyethylene plastic.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. PE: Polyethylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency. Origin of product to be domestic. No imported product will be acceptable.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 and CISPI 301 and marked with the collective trademark of the CISPI and listed by NSF International.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve. Coupling shall be listed by NSF International.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: ASTM C 1540, with stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve. Coupling shall be listed by NSF International.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.

2.4 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Extra-Heavy or Service class and marked with the collective trademark of the CISPI and listed by NSF International.
- B. Gaskets: ASTM C 564 and ASTM C 1563, rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.5 STEEL PIPE AND FITTINGS

- A. Steel Pipe Nipples: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

2.6 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- C. Soft Copper Tube: ASTM B 88, Types L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.7 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.8 PEX PIPING AND FITTINGS

- A. PEX Tubing: ASTM F876 & F877 Grade A.
 - 1. Redbrass Male Threaded Adapter
 - a. Manufacturers:

1) Uponor Aqua Pex

2.9 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
- D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Specification Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions shall be provided and installed at equipment connections and appurtenances.
- B. Indirect drainage piping for equipment connections shall be any of the following:

1. Copper DWV tube, copper drainage fittings, and soldered joints
- C. Below-floor (crawl space), condensate drain and vent piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Above-floor, condensate drain and vent piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Underground, condensate drain and vent piping shall be any of the following:
 1. Extra-Heavy class, cast-iron soil piping, hub and spigot; and gasketed joints.
 2. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- F. Below-floor (crawl space), soil, waste and vent piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; heavy duty, shielded, stainless-steel couplings; and hubless-coupling joints. **(Required for use in Boiler Room, Kitchen and for Greasewaste)**
 2. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints. **(not permitted in Boiler Room, Kitchen or for Greasewaste)**
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- G. Above-floor, soil, waste and vent piping shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Galvanized steel nipples.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- H. Underground, soil, waste, vent piping shall be any of the following:
 1. Extra-Heavy class, cast-iron soil piping, hub and spigot; and gasketed joints. **(Required for use in Boiler Room, Kitchen and for Greasewaste)**
 2. Solid-wall, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints. **(Not permitted in Boiler Room, Kitchen or for Greasewaste)**
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- I. Above and below floor (crawl space), trap primer drainage piping shall be any of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 2. All piping in masonry block wall/chase to be wrapped in 6 mil poly-sleeve.
- J. Under-building-slab/in slab, trap primer drainage piping shall be any of the following:
 1. Soft copper tube, ASTM B 88, Type L; cast- or wrought- copper brazed-joint fittings; and brazed joints.
 2. PEX Tubing: ASTM F877 and F876, NSF Standard 14 and 61; brass fittings; No joints in slab (other than fixture connections).

3. All underslab/in-slab piping to be wrapped in 6 mil poly-sleeve.
 - K. Above-floor, pumped drain piping shall be any of the following:
 1. Black steel pipe with either threaded or grooved joints and fittings.
 2. Type K copper tube with either pressed or brazed joints and fittings.
 - L. Below-floor (crawl space), pumped drain piping shall be any of the following:
 1. Galvanized steel pipe with either threaded or grooved joints and fittings.
 2. Type K copper tube with either pressed or brazed joints and fittings.
 - M. Acid Waste and Vent Piping: Reference Acid Waste and Vent Piping Specification.
- ### 3.3 PIPING INSTALLATION
- A. Condensate shall be indirectly discharged into the sanitary drainage system through a 2-inch air gap (into a floor drain or hub drain) and shall not be directly connected (hard piped).
 - B. Indirect drainage piping shall be discharged into the sanitary drainage system through a 2-inch air gap (into a floor or hub drain) and shall not be directly connected (hard piped).
 - C. Provide clean outs as indicated on drawings and per local codes.
 - D. Lead fittings are not acceptable.
 - E. Sanitary sewer piping outside the building is specified in Specification Section "Facility Sanitary Sewers."
 - F. Basic piping installation requirements are specified in Plumbing Specification Section "Basic Plumbing Materials and Methods."
 - G. 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. Sleeves and mechanical sleeve seals are specified in Plumbing Specification Section "Basic Plumbing Materials and Methods."
 - H. Install sleeves for all pipes passing through walls and concrete floors. **Refer to Plumbing Specification Section "Basic Plumbing Materials and Methods" for requirements.**
 - I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings." Lead fittings are not acceptable.
 - J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use fixture fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 135 degrees without the installation of a cleanout. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for all piping.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
 - M. Install engineered soil and waste drainage and vent piping systems as follows:
 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by engineer and authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Plumbing Specification Section "Basic Plumbing Materials and Methods."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- D. Solder Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- E. Joint Restraints and Sway Bracing:
 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.5 VALVE INSTALLATION

- A. Provide and install backwater valves in sanitary main entering the building where the top of the manhole is at a higher elevation than the finished floor of the first floor.
- B. Backwater Valves:
 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 2. Install backwater valves in accessible locations.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Contractor is responsible for coordination with all other trades.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
 5. Stainless steel flanges required at water fixture drain connection.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of engineer and 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 inspections by engineer and authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If engineer or authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by engineer and authorities having jurisdiction.
- D. Test sanitary drainage and vent piping as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. **Final Plumbing Test Procedure:** After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Contractor shall introduce smoke into piping system continuously until the entire system has been approved by the engineer and the owner's representative.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 1319
DRAIN PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
1. Cleanouts.
 2. Floor drains.
 3. Roof Drains.
 4. Miscellaneous sanitary drainage piping specialties.
 5. Miscellaneous storm drainage piping specialties.
 6. Solids interceptors.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases for outdoor cleanouts.
- B. Coordinate size and location of roof penetrations and flashing requirements with architectural.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be 51% manufactured in the United States, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.

2.2 CLEANOUTS

- A. Exposed Metal Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk or raised-head, brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 - 3. Size: Same as connected branch.
 - 4. Type: Threaded, adjustable housing.
 - 5. Body or Ferrule: Cast iron.
 - 6. Clamping Device: Not required.
 - 7. Outlet Connection: Spigot.
 - 8. Closure: Brass plug with straight threads and gasket.
 - 9. Adjustable Housing Material: Cast iron with threads.
 - 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 11. Frame and Cover Shape: Round.
 - 12. Top Loading Classification: Heavy Duty.
 - 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
 - 14. Standard: ASME A112.3.1.
 - 15. Size: Same as connected branch.
- C. Cast-Iron Wall Cleanouts:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
 - 5. Closure: Countersunk, brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.3 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawing "Floor Drain Schedule" or a comparable product by one of the following:

- a. Josam Company; Josam Div.
- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Light Commercial Operation.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Seepage Flange: Required.
4. Anchor Flange: Required.
5. Outlet: Bottom.
6. Backwater Valve: Not required.
7. Trap Pattern: Standard P-trap, unless otherwise indicated.
8. Other Requirements: Refer to drawing schedule and provide full model equivalency.

2.4 ROOF DRAINS

- A. Metal Roof Drains:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group.
 2. Standard: ASME A112.21.2M.
 3. Pattern: Roof drain.
 4. Body Material: Cast iron.
 5. Dimensions of Body: Reference Roof Drain Schedule on Drawings.
 6. Combination Flashing Ring and Gravel Stop: Required.
 7. Flow-Control Weirs: Not required.
 8. Outlet: Bottom.
 9. Dome Material: Cast iron.
 10. 2" Extension Collars: Required for overflow drains only.
 11. Underdeck Clamp: Required.
 12. Sump Receiver: Required.
- B. Metal Combination Roof Drains (Primary and Overflow):
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group.
 2. Standard: ASME A112.21.2M.
 3. Pattern: Roof drain.
 4. Body Material: Cast iron.
 5. Dimensions of Body: Reference Roof Drain Schedule on Drawings.
 6. Combination Flashing Ring and Gravel Stop: Required.
 7. Flow-Control Weirs: Not required.
 8. Outlet: Bottom.
 9. Dome Material: Cast iron.

10. 2" Extension Collars: Required for overflow drain only, internal.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.
13. Separate outlets for each drain (two total).

2.5 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies: Refer to architectural drawings and specifications for requirements.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Hub Drains:
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.7 MISCELLANEOUS STORM DRAIN PIPING SPECIALTIES

- A. Downspout Boots:
1. Description: Manufactured, Dura-coated cast iron body, with strap or ears (with last bolt holes) for attaching to building.
 2. Size: Inlet size to match downspout; outlet size NPS 4.
- B. Downspout Nozzles:
1. Description:
 - a. Plain, bronze body with threaded inlet and bronze wall flange with mounting holes. (Cast iron conductor)
 - b. Cast nickel-bronze construction, push on PVC connection, nickel-bronze bolt-on escutcheon and security ring (PVC conductor).
 2. Size: Same as connected conductor.

2.8 SOLIDS INTERCEPTORS

- A. Solids Interceptors:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings "Plumbing Fixture Schedule" or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.

3. Body Material: Cast iron or steel.
4. Interior Lining: Corrosion-resistant enamel.
5. Exterior Coating: Corrosion-resistant enamel.
6. End Connections: Threaded.
7. Other Requirements: Refer to drawing schedule and provide full model equivalency.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Plumbing Specification Section "Basic Plumbing Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Provide and install cleanouts (in addition to those indicated on the drawings) in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 135 degrees.
 3. Locate at maximum intervals of 50 feet for piping.
 4. Locate at base of each vertical soil and waste stack.
 5. Locate one cleanout for each restroom.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame anchored to reinforcement or studs and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to architectural requirements.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on roof drains, sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Assemble open drain fittings and install with top of hub 2 inches above floor.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
 3. Connection to floor drain body is not acceptable.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- L. Install reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Plumbing Specification Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Refer to architectural roofing drawings and specifications for requirements.
- B. Install flashing for piping passing through roofs with counter-flashing or commercially made flashing fittings, according to Specification Section "Sheet Metal Flashing and Trim."
- C. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- D. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 1940
FUEL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fuel gas piping within the building. Products include the following:
1. Pipe, tube, fittings, and joining materials.
 2. Protective pipe and fitting coating.
 3. Piping specialties.
 4. Specialty valves.
 5. Joining materials.
 6. Pressure regulators.
- B. Related Sections include the following: Division 2 Section "Natural Gas Distribution" for natural gas service piping, specialties, and accessories outside the building.

1.3 PROJECT CONDITIONS

- A. Gas System Pressure: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2.0 psig, and is reduced to secondary pressure of 0.5 psig or less.
- B. Design values of fuel gas supplied for these systems are as follows:
1. Normal Heating Value: 1000 Btu/cu. ft.
 2. Nominal Specific Gravity: 0.6.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Pipes, tubes, fittings, and joining materials.
 2. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 3. Pressure regulators. Include pressure rating, capacity, and settings of selected models.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For natural gas specialties and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Quality processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Electrical Components and Devices: 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. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.6 COORDINATION

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- A. Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; black. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.
 1. Malleable-Iron Threaded Fittings: ASME B 16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint and threaded ends according to ASME B1.20.1.
 5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
 6. Joint Compound and Tape: Suitable for natural gas.
 7. Steel Flanges and Flanged Fittings: ASME B16.5.
 8. Gasket Material: Thickness, material and type suitable for natural gas.
- B. PE Pipe: ASTM D 2513, SDR 11.
 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.4 SPECIALTY VALVES

- A. Valves, NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

- B. Valves, NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- C. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig minimum pressure rating.
- D. Gas Valves, NPS 2 and Smaller: ASME B16.33 and CSA International-listed bronze body and 125-psig pressure rating.
 - 1. Manufacturers:
 - a. BMI Canada, Inc.
 - b. Crane Valves
 - c. Dungs, Karl, Inc.
 - d. Flow Control Equipment, Inc.
 - e. Grinnel Corp.
 - f. Honeywell International Ltd.
 - g. KITZ Corporation
 - h. Legend Valve and Fitting, Inc.
 - i. Lyall, R.W. & Co., Inc.
 - j. McDonald, A.Y. Mfg. Co.
 - k. Milwaukee Valve Company
 - l. Mueller Co.; Mueller Gas Products Div.
 - m. NIBCO INC.
 - n. Red-White Valve Corp.
 - o. Velan Inc.
 - p. Watts Industries, Inc.; Water products Div.
 - 2. Tamperproof Feature: Include design for locking.
- E. Plug Valves, NPS 2-1/2 and larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.
 - 1. Manufacturers:
 - a. Flow Control Equipment, Inc.
 - b. Milliken Valve Co., Inc.
 - c. Nordstrom Valves, Inc.
 - d. Olson Technologies, Inc.; Homestead Valve Div.
 - e. Walworth Co.
 - 2. Tamperproof Feature: Include design for locking.
- F. General-Duty Valves, NPS 2-1/2 and Larger: ASME B16.38, cast-iron body, suitable for fuel gas service, with "WOG" indicated on valve body, and 126-psig pressure rating.
 - 1. Gate Valves: MSS SP-70, OS&S type with solid wedge.
 - 2. Butterfly Valves: MSS SP-67, lug type with lever handle.
- G. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.
 - 1. Manufacturers:
 - a. ASCO General Controls.
 - b. ASCO Power Technologies, LP; Division of Emerson
 - c. ASCO Valve Canada, Division of Emerson Electric Canada Limited.
 - d. Dungs, Karl, Inc.
 - e. Eaton Corporation; Controls Div.
 - f. Eclipse Combustion, Inc.
 - g. GPS Gas Protection Systems, Inc.
 - h. Honeywell International Inc.
 - i. Johnson Controls

2.5 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches (1830 mm).
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller.
 - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig (862 kPa).
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.6 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.7 PRESSURE REGULATORS

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller.
- B. Line Pressure Regulators: Comply with ANSI Z21.80.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.

- g. Richards Industries; Jordan Valve Div.
3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
7. Orifice: Aluminum; interchangeable.
8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
10. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Overpressure Protection Device: Factory mounted on pressure regulator.
12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
13. Maximum Inlet Pressure: 2 psig.

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.

3.2 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774. Adjacent to piping, provide with a continuous length of yellow insulated copper tracer wire; #12 AWG (min.); suitable for direct burial.
- D. Steel Piping with Protective Coating:
 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- I. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages."

3.3 INDOOR PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Fuel Gas Piping, 2 psig or Less:
 - 1. NPS 1/2 and Smaller: NPS 3/4 steel pipe, malleable-iron threaded fittings, and threaded joint. No fuel gas piping shall be smaller than NPS 3/4; provide reducers at equipment where required.
 - 2. NPS 3/4 and NPS 1: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 3. NPS 1-1/4 to NPS 2: Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 4. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

3.4 VALVE APPLICATIONS

- A. Piping Line Valves, NPS 2 and Smaller: Gas valve.
- B. Piping Line Valves, NPS 2-1/2 and Larger: Plug valve or general-duty valve.

3.5 PIPING INSTALLATION

- A. Basic piping installation requirements and piping joint construction are specified in Specification Section "Basic Mechanical Materials and Methods."
- B. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- C. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors and in floor channels, unless indicated to be exposed to view.
- D. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- E. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- F. Connect branch piping from top or side of horizontal piping.
- G. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- H. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- I. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Specification Section "Meters and Gauges."
- J. Install flanges on valves, specialties, and equipment having NPS 2-1/2 and larger connections.
- K. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- L. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents

with turned-down, reducing-elbow fittings with corrosion-resistant insect in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.6 JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Specification Section "Basic Mechanical Materials and Methods."
- B. Use materials suitable for fuel gas.
 - 1. Brazed Joints: make with brazing alloy with melting point greater than 1000 deg. F. Brazing alloys containing phosphorus are prohibited.
- C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Specification Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.
- E. Ground equipment according to Specification Section "Grounding and Bonding."
 - 1. Do not use gas pipe as grounding electrode.
- F. Connect wiring according to Specification Section "Conductors and Cables."

3.9 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate for sign on or near each service meter, pressure regulator, and specialty valve.
 - 1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 2. Nameplates, pipe identification, and signs are specified in Specification Section "Mechanical Identification."

3.10 PAINTING

- A. Use materials and procedures in painting specification Sections.
- B. Paint exterior piping (including rooftop applications).
 - 1. Color: Yellow

3.11 FIELD QUALITY CONTROL

- A. Test, inspect, and purge piping according to NFPA 54 and requirements of authorities having jurisdiction.

- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- D. Verify correct pressure settings for pressure regulators.
- E. Verify that specified piping tests are complete.

END OF SECTION

SECTION 22 3400
FUEL-FIRED, DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. All work performed under this Section of the Specifications shall be in strict accordance with the provisions of Section SPECIAL CONDITIONS FOR PLUMBING WORK and the BASIC PLUMBING MATERIALS AND METHODS SECTIONS.

1.2 SUMMARY

- A. This Section includes the following for domestic water systems:
 1. Commercial, gas water heaters.
 2. Compression tanks.
 3. Accessories.
- B. Related Sections include the following:
 1. Specification Section "Valves" for general duty valves.
 2. Specification Section "Natural Gas Piping" for natural gas piping and connections.
 3. Specification Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 4. Specification Section "Water Distribution Piping" for water-supply piping and connections.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Wiring Diagrams: Power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.
- C. Specification Compliance Review:
 1. Manufacturers and bidders must provide the consulting engineer with a Compliance Review of the Specifications and Addenda's. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications and schedule with the following information "C", "D", or "E" marked in the margin of the original Specifications and any subsequent Addenda's. If the manufacturer or bidder does not provide the Compliance Review to the engineer for review, with the submittal, the submittal will be subject to rejection as non-compliant.
 - a. "C" Comply with no exceptions.
 - b. "D" Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - c. "E" Exception do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives. Non-compliance with the specifications is grounds for rejection as unacceptable. A bid from any alternative or listed equipment manufacturer with any number of exceptions will be reason for rejection for non-compliance without further review.
 - d. Unless a deviation or exception is specifically noted in the Compliance Review, the manufacturer shall provide full compliance with entire specification. Deviations or exceptions taken in letters or cover letters in a bid document, subsidiary documents, by omission or by contradiction do not release the manufacturer or bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review and approved by the consulting engineer.

- e. Equipment manufacturers or bidders that do not meet the specifications thru the above process will be subject to rejection without further review.
- D. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
- E. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
- F. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ANSI Compliance: Provide gas water heaters that comply with ANSI standards for gas water heaters and related products and that bear AGA certification label.
- E. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- F. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
 - 2. ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings," for household water heaters.

1.5 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include storage tanks and burner assemblies.
- C. Warranty Period: From date of Substantial Completion:
 - 1. Storage Tanks: Five (5) years.
 - 2. Circulators: Five (5) years.
 - 3. Burner Assemblies: Five (5) years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commercial, Storage, Forced-Draft, Low NO_x Gas Water Heaters:
 - a. A.O. Smith Water Products Co.
 - b. PVI Industries, Inc.
 - 2. Commercial, High-Efficiency, Condensing, Low NO_x Gas Water Heaters:
 - a. A.O. Smith Water Products Co.
 - b. PVI Industries, Inc.

3. Commercial, Water Tube, Induced Draft, Low NO_x Gas Water Heaters:
 - a. A.O. Smith Water Products Co.
 - b. Lochinvar Corp.
 - c. Raypak, Inc.
 - d. Rheem Manufacturing Co. (Rheem Water Heater Div.)
 - e. RBI Water Heaters
4. Compression Expansion Tanks:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Smith: A.O. Smith; Aqua-Air Div.
 - d. Taco, Inc.
 - e. Wessels Co.
 - f. Watts.
5. Water Heater Stand and Drain Pan Units:
 - a. Safety: W. H. Safety Products, Inc.

2.2 COMMERCIAL, STORAGE, FORCED-DRAFT OR INDUCED DRAFT, GAS WATER HEATERS, LOW NO_x, NON-CONDENSING

- A. Description:
 1. The water heater will operate at a minimum of 82% thermal efficiency when tested by an independent laboratory to ANSI Z21.10.3. The water heater will comply with Para. 7.2.4.4, the thermal efficiency, the standby loss, and all other requirements of ASHRAE 90.1-2007.
 2. Note that unit is **non-condensing**, 82% efficient, Type B vent.
- B. Standard Gas Pressure Requirements: Maximum static pressure 7" - 14" w.c.
- C. Venting Requirements:
 1. -.02" to -.06" w.c. (negative pressure).
 2. Type B venting.
- D. Standard Electrical Requirements: Control voltage 120V, 1 phase, 60 Hz, 2 amps.
- E. Shell Construction - Section IV: ASME-code steel with 150-psig minimum working-pressure rating.
 1. Fire Tubes: Vertical, single-pass, copper-clad, seamless steel.
 2. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
 - b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 3. Interior Finish: As specified, materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 4. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 5. Jacket: Steel, with enameled finish.
- F. Components, Gas Train, and Controls: Manufacturer's standard, unless otherwise indicated.
- G. Burner: Forced-draft assembly for natural-gas fuel made with nozzles for fire tubes, and complying with appropriate requirements of UL 795. Combustion will be provided by a forced-draft power burner with a UL gas train metting the agency requirement for the input specified. Burner and heating section will be certified by independent laboratory to operate with NO_x emissions not to exceed 30 ppm corrected to 3% O₂ (at or above 400,000 Btu) and 55 ppm corrected to 3% O₂ or 40 nanograms per joule (below 400,000 Btu). Water heater

will be a Category I, non-condensing appliance. It will be UL listed for use with non-pressurized, Type B venting material.

1. Temperature Control: Adjustable thermostat.
 2. Safety Controls: As a minimum, the heater will be equipped with the following:
 - a. Electronic flame monitoring with pre- and post-purge.
 - b. Two **immersion** operating thermostats.
 - c. An **immersion** temperature limiting device.
 - d. An ASME- or AGA-rated temperature and pressure relief valve.
 - e. 82% thermal efficiency.
 - f. NO_x emissions certified at < 55 ppm at 3% O₂ (199 to 399 Mbtu/h).
 - g. NO_x emissions certified at < 30 ppm at 3% O₂ (above 399 Mbtu/h).
 - h. Copper-clad, steel fire tubes.
 - i. Non-ferrous and removable fittings for all tank connections.
 - j. Upper and lower immersion operating thermostats.
 - k. Immersion temperature limiting device (high limit control).
 - l. ASME-rated temperature and pressure relief valve.
 - m. Drain valve.
 - n. Handhole tank cleanout.
 - o. Forced-draft power burner.
 - p. UL- and FM-compliant gas train.
 - q. Spark ignition.
 - r. Differential pressure airflow switch.
 - s. Second main gas valve (540,000 Btu/h and higher).
 - t. ASHRAE 90.1 compliant for thermal efficiency and standby losses.
 - u. Fiberglass insulated tank.
 - v. Steel jacket panels with durable finish.
 - w. ASME stamped 225 psi test pressure.
 - x. National Board registered for 150 psi working pressure.
 - y. UL listed to safety standard UL 795 "Commercial-Industrial Gas Heating Equipment".
 - z. UL listed for use with a Type B vent (Category I appliance).
 - aa. Dial temperature and pressure gauges.
 - bb. Electronic low water cutoff.
 - cc. Manual-reset, temperature limiting device.
 - dd. Second main gas valve (for inputs below 540,000 Btu/h).
 - ee. Alarm bell with silencing switch.
 3. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
- H. Anode Rods: Factory installed magnesium.
- I. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- J. Mounting: Factory-fabricated, structural-steel skids.
- 2.3 COMMERCIAL, STORAGE, INDUCED-DRAFT, GAS WATER HEATERS, CONDENSING, LOW NO_x**
- A. Description:
1. NO_x emissions will not exceed 20 ppm when corrected to 3% O₂. These levels will be certified by an independent laboratory.
 2. The water heater will operate at a minimum of 95% thermal efficiency when tested to ANSI Z21.10.3. The water heater will comply with Para. 7.2.4.4, the thermal efficiency, the standby loss, and all other requirements of ASHRAE 90.1-2007.
 3. The water heater will comply with appropriate requirements of UL 795.
- B. Shell Construction: Non-ASME-code steel with 150-psig working-pressure rating. The water heater will be vertical fire tube design. Both storage and heating sections of the water heater

will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure. The fireside of the heating surfaces will be of boiler-grade steel. The waterside of the heating tubes will be sealed in copper. The heating tubes will be rolled, beaded, and seal welded into the tube sheets. The combustion side of the tube sheet will be insulated by a layer of ceramic fiber that will protect the tube sheet from both thermal stresses and failure that can result from the accumulation scale and precipitants.

1. Fire Tubes: Single-pass, copper-clad, seamless steel.
 2. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends.
 3. Interior Finish: As specified, materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 4. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 5. Jacket: Steel, with enameled finish.
- C. Components, Gas Train, and Controls: Manufacturer's standard, unless otherwise indicated.
- D. Burner and Venting: Combustion will be provided by an induced-draft power burner with a gas train meeting UL and FM agency requirements for the input specified. Water heater will be a Category IV, condensing appliance, UL listed for use with CPVC vent or AL 29-4C stainless steel vent. Burner will be configured to accept room air or direct inlet combustion air (as indicated). Water heater will operate with a minimum gas pressure of 7" - 14" water column.
1. Temperature Control: Adjustable thermostat.
 2. Safety and Control Features: **As a minimum**, the heater will be equipped with the following:
 - a. A solid-state flame safeguard with pre-purge, programmable post-purge, and flame status indicating lights.
 - b. Two **immersion** operating thermostats.
 - c. An **immersion** temperature limiting device.
 - d. A stack temperature limiting device.
 - e. An ASME-rated temperature and pressure relief valve.
 - f. Electronic flame safeguard with pre-purge (UL, FM, CSA).
 - g. Flame status indicating lights (airflow, flame, pilot trial for ignition, and alarm).
 - h. Programmable post-purge.
 - i. Induced draft blower.
 - j. Factory equipped for direct venting and direct inlet air for up to 100 equivalent feet.
 - k. UL listed for use with CPVC venting material.
 - l. Tank circulator with intermittent pump operation.
 - m. Stack temperature limiting device.
 - n. Upper and lower immersion operating thermostats.
 - o. Immersion temperature limiting device (high limit control).
 - p. Remote on/off terminals.
 - q. ASME-rated temperature and pressure relief valve.
 - r. Drain valve.
 - s. Handhole tank cleanout.
 - t. UL-compliant gas train.
 - u. ASHRAE 90.1 compliant for thermal efficiency, and standby heat and electrical loss.
 - v. Fiberglass tank insulation.
 - w. Steel jacket panels with durable powder coat finish.

- x. Factory authorized startup.
- y. ASME stamped 225 psi test pressure.
- z. National Board registered for 150 psi working pressure.
- aa. UL/ULC listed to safety standard UL 795 "Commercial-Industrial Gas Heating Equipment".
- bb. Condensate neutralization system with flue gas trap.
- cc. Dial temperature and pressure gauges.
- dd. Electronic low water cutoff.
- ee. Manual-reset, immersion temperature limiting device.
- ff. Alarm bell with silencing switch.
- 3. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
- E. Anode Rods: Factory installed magnesium.
- F. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed. $\frac{3}{4}$ ", $\frac{1}{4}$ turn bronze ball valve, stainless steel trim and ball, $\frac{3}{4}$ " hose thread adaptor and cap.
- G. Mounting: Factory-fabricated, structural-steel skids.

2.4 COMMERCIAL WATER-TUBE GAS WATER HEATERS, NON-CONDENSING, LOW NO_x

- A. Description: Comply with UL 795 and ANSI Z21.13. Assembly shall include storage tanks, circulators, piping, and controls as indicated on drawings.
- B. Water Heater: Enclosed, insulated unit with 24-VAC controls.
 1. Construction: According to ASME Boiler and Pressure Vessel Code: Section IV with 150-psig working-pressure rating.
 2. Heat Exchanger: Copper, horizontal-grid, finned-tube with glass-lined cast-iron headers mechanically joined to the tubes (gasket-type not acceptable). Provide inlet/outlet thermometers.
 3. Include auxiliary terminal strip on for connection to building control system.
 4. Burner
 - a. Low- NO_x certified to operate with NO_x emissions that do not exceed 55-ppm at 3% O₂ (75 to 399-Mbtu/h) and 30-ppm at 3% O₂ (above 399-Mbtu/h).
 - b. Fan-assisted induced draft.
 - c. Natural gas fuel; provide gas train necessary for use with line pressure of 14 in-wc.
 - d. Minimum 82% thermal efficiency.
 - e. Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - f. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - g. Automatic Ignition: Hot-surface ignition with flame monitoring capability.
 - h. Venting: Conventional negative draft (-0.02 to -0.06" wg) venting compatible with Type "B" double-wall vent pipe. Combustion air shall be non-ducted room air that will be supplied from a louver.
- C. Hot-Water Storage Tank:
 1. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with 150-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - 1) NPS 3 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads
 - b. Interior Finish: Glass lined. Extend finish into and through tank fittings and outlets.
 - c. Insulation: Comply with International Energy Code (2009) and ASHRAE 90.1 for Maximum standby loss (percent/hour). Surround entire storage tank except

- connections and controls.
- d. Jacket: Galvanized Steel.
 - e. Manufacturer's standard manhole access port.
2. Anode Rods: Factory installed magnesium.
 3. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- D. Circulators: UL 778, all bronze, in-line, centrifugal, single-stage, radially split case design, with mechanical seals with 125-psig- minimum working-pressure rating and 225 deg F continuous water temperature.

2.5 COMPRESSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- B. Construction: 150-psig working-pressure rating.
- C. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- D. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- E. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.
- F. Air-Charging Valve: Factory installed.

2.6 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: According to the following:
 1. Gas Water Heaters: ANSI Z21.22, combination temperature and pressure relief valve.
 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
 3. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
 4. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping.
- B. Pressure Relief Valves: According to the following:
 1. Gas Water Heaters: ANSI Z21.22 pressure relief valve for storage tanks of 200,000 Btuh.
 2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than heat-exchanger working-pressure rating.
- C. Vacuum Relief Valves: According to the following:
 1. Gas Water Heaters: ANSI Z21.22.
 2. Oil-Fired Water Heaters: Comply with ASME PTC 25.3. Furnish for installation in piping.
 3. Exception: Omit if water heater has integral vacuum-relieving device.
- D. Gas Shutoff Valves: ANSI Z21.15 manually operated. Furnish for installation in piping.
- E. Gas Pressure Regulators: ANSI Z21.18, appliance type, factory or field installed. Include pressure rating, capacity, and pressure differential required for water heater and gas supply.
- F. Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- G. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch-high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1, pipe thread.

- H. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- I. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.
- J. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4. Drain pans shall be provided for storage tanks or storage-type water heaters whether indicated or not on drawings.
- K. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- L. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated. Refer to Division 3 Section "Cast-in-Place Concrete" and Specification Section "Basic Mechanical Materials and Methods."

3.2 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Anchor water heaters to substrate.
- D. Install and connect gas water heaters according to NFPA 54.
 - 1. Install appliance, gas pressure regulators on gas-burner inlets of water heaters without pressure regulators.
 - 2. Install vent piping from gas-train pressure regulators and valves to outside of building where required. Terminate vent piping with brass-screened vent cap fitting. Do not combine vents except with approval of authorities having jurisdiction.
- E. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- F. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- G. Install vacuum relief valves in cold-water-inlet piping.
- H. Install vacuum relief valves in water heater storage tanks that have copper lining.
- I. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Specification Section "Plumbing Specialties" for drain valves.
- J. Install thermometers on water heater inlet and outlet piping. Refer to Specification Section "Meters and Gages" for thermometers.
 - 1. Exception: Omit thermometers for the following:
 - a. Commercial, point-of-use, water heater inlet piping.

- K. Install pressure gages on water heater piping. Refer to Specification Section "Meters and Gages" for pressure gages.
 - 1. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Specification Section "Valves" for general-duty valves and Specification Section "Meters and Gages" for thermometers.
 - 2. Arrange for insulation on equipment and piping not furnished with factory-applied insulation. All field-installed insulation shall comply with requirements of the 2009 IECC.
 - 3. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
 - 4. Fill water heaters with water.
 - 5. Fill storage tanks with water.
 - 6. Charge compression tanks with air.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Specification Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Connect gas piping to gas burner with drip leg, tee, shutoff valve, and union; minimum size same as inlet connection.
- E. Connect oil piping to oil burner with shutoff valve and union in supply, and check valve and union in return.
- F. Make connections with dielectric fittings where piping is made of dissimilar metal.
- G. Gas, Water Heater Vent Connections: Connect to vent system. Include draft hoods and diverters where required. Use vents same size as or larger than water heater outlets, but not smaller than indicated unless smaller vent size has been calculated according to NFPA 54. Comply with gas utility requirements for sizing. Gas vents are specified in Specification Section "Breechings, Chimneys, and Stacks."
- H. Oil-Fired, Water Heater Vent Connections: Connect to vent system. Include draft diverters where required. Use vents same size as or larger than water heater outlets, but not smaller than indicated. Oil-fired vents are specified in Specification Section "Breechings, Chimneys, and Stacks."
- I. Electrical Connections: Power wiring and disconnect switches are specified in Specification Sections. Arrange wiring to allow unit service. Coordinate with electrical drawings.
- J. Control Connections: Water heating systems controls shall be integrated with mechanical and/or building control systems as indicated on drawings.
 - 1. Connect to building control systems and energy management systems as indicated on drawings. Coordinate with mechanical and plumbing drawings.
- K. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturers 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. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
2. Verify that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Check operation of circulators.
6. Test operation of safety controls, relief valves, and devices.
7. Energize electric circuits.
8. Adjust operating controls.
9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
10. Balance water flow through manifolds of multiple-unit installations.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
 1. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.
 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 3. Review date in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 22 4100
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 the following conventional plumbing fixtures and related components:

1. Faucets for lavatories.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Dishwasher air-gap fittings.
7. Disposers.
8. Water closets.
9. Urinals.
10. Lavatories.
11. Commercial sinks.
12. Kitchen sinks.
13. Service basins.
14. Utility Boxes

- B. Related Sections include the following:

1. Specification Section "Site Water Utility Distribution Piping" for exterior plumbing fixtures and hydrants.
2. Specification Section "Toilet, Bath, and Shower Accessories."
3. Specification Section "Emergency Plumbing Fixtures."
4. Specification Section "Water Coolers."
5. Specification Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities; and is compliant with the Texas Accessibility Standards (TAS), Article 9102, Texas Civil Statutes.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in the Texas Accessibility Standards (TAS), Architectural Barriers Act, Article 9102, Texas Civil Statutes.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 2. Faucets: ASME A112.18.1.
 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 6. NSF Potable-Water Materials: NSF 61.
 7. Pipe Threads: ASME B1.20.1.
 8. Supply Fittings: ASME A112.18.1.
 9. Brass Waste Fittings: ASME A112.18.2.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 6. Pipe Threads: ASME B1.20.1.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

- A. Warranty Period: Two (2) years from dated of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Cartridge, Assembly and Associated O-Rings: Equal to 2 or 5 percent of amount of each type and size installed (whichever is greater).
 2. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Product descriptions hereinafter represent minimum requirements for each fixture; refer to Basis-of-Design manufacturer and model number listed on the drawing "Plumbing Fixture Schedule" for additional features, construction details, accessories and/or options.

2.2 MATERIALS AND WORKMANSHIP

- A. **All materials, unless otherwise specified, shall be 51% manufactured in the United States, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.**
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.

2.3 STOPS

- A. Angle Stops:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (unless noted otherwise on drawings or on schedule).
 - a. Chicago Faucets.
 - b. McGuire Manufacturing Co., Inc.
 - c. T & S Brass and Bronze Works, Inc.
 2. Description: Heavy duty cast brass with compression cartridge.
 - a. Finish: Chrome plated.
 - b. Stem: Brass, full turn.
 - c. Operation: Loose Key, unless otherwise indicated.
 - d. Outlet: NPS 3/8, compression
 - e. Inlet Size: NPS 1/2, female thread.

2.4 LAVATORY FAUCETS

- A. Lavatory Faucets, Manual:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 2. Description: Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.5 gpm. (unless noted otherwise on drawings or within Schedule)
 - d. Valve Handle(s): Wrist blade, 4 inches.

- e. Spout Outlet: Aerator.
 - f. Operation/Cartridge: Ceramic disk, manual.
- B. Lavatory Faucets, Automatic, Metering:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 - 2. Description: Push button operated, metering; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.5 gpm, (unless noted otherwise on drawings or within Schedule). 10 seconds (maximum) flow time.
 - d. Mixing Valve: None, cold water only.
 - e. Spout Outlet: Aerator, vandal resistant.
 - f. Operation: Manual push button.

2.5 SINK FAUCETS

- A. Sink Faucets, Manual, Single Hole:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 - 2. Description: One or two-handle valve. Include cold and hot-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm, (unless noted otherwise on drawings or within Schedule)
 - d. Mixing Valve: None.
 - e. Handle: Wrist blade, 4 inches; coordinate single handle (CW only) units with floor plans such that lever is always located on front side of counter/sink.
 - f. Spout Outlet: Aerator.
 - g. Operation: Compression, manual.
- B. Sink Faucets, Manual:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 - 2. Description: Two-handle mixing. Include cold and hot-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm, (unless noted otherwise on drawings or within Schedule)
 - d. Mixing Valve: None.
 - e. Handles: Wrist blade, 4 inches.
 - f. Spout Outlet: Aerator.

- g. Operation: Compression, manual.
- C. Sink Faucets, Kitchen:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. Chicago Faucets.
 - b. T & S Brass and Bronze Works, Inc.
 2. Description: Kitchen faucet without spray, single-handle mixing. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.2 gpm, (unless noted otherwise on drawings or within Schedule).
 - d. Mixing Valve: Integral to cartridge.
 - e. Handle: Lever, minimum 4 inches;
 - f. Spout Outlet: Aerator.
 - g. Operation/Cartridge: Manual, ceramic disk mixing.

2.6 FLUSHMETERS

- A. Flushometers, Automatic:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. Sloan Valve Company.
 2. Description: Flushometer for water-closet or urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve and vandal resistant stop cap, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Trip Mechanism: Oscillating, lever-handle actuator.

2.7 TOILET SEATS

- A. Toilet Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Kohler Co.
 2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check.
 - e. Class: Heavy-duty commercial.
 - f. Color: White.

2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. McGuire Manufacturing Co., Inc.
 - b. TRUEBRO, Inc.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.9 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
 1. Description: Combination carrier designed for mounting height of wall-mounting, water-closet-type fixture. 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. Factory painted.
- C. Urinal Supports:
 1. Description: Type I, manufactured urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet. Factory painted.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
 1. Description: Type II, manufactured lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet. Factory painted.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Securements
 1. Stainless Steel drop in anchors with heavy-duty class stainless steel bolts. All-threaded is not acceptable.

2.10 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide product (or provide Dishwasher loop where local jurisdiction allows):
 - a. Watts Brass & Tubular; a division of Watts Regulator Co.
 2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch ID inlet and 7/8-inch ID outlet hose connections.
 3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.11 DISPOSERS

- A. Disposers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. In-Sink-Erator; a div. of Emerson Electric Co.
 - b. KitchenAid.
 2. Description: Batch-feed household, food-waste disposer. Include reset button; switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or

shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.

- a. Type: Batch-feed household.
- b. Model: Sound-insulated chamber.
- c. Motor: 115-V ac.
- d. Minimum 1/2 HP motor

2.12 WATER CLOSETS

A. Water Closets, Floor Mounted, ADA-Compliant:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule)
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan (Water Closets/Flush Valve combo)
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: One piece.
 - 1) Bowl Type: Elongated with siphon-jet design; include bolt caps matching fixture.
 - 2) Design Consumption: 1.28 gal./flush (unless noted otherwise on drawings or within Schedule).
 - 3) Color: White.
 - 4) Toilet Seat: Required; see other paragraph.
 - 5) Flushometer: Required; see other paragraph.
3. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design; include bolt caps matching fixture.
 - 2) Height: Accessible, 16-3/4".
 - 3) Design Consumption: 1.28 gal./flush (unless noted otherwise or within Schedule).
 - 4) Color: White.
 - 5) Toilet Seat: Required; see other paragraph.
 - 6) Flushometer: Required; see other paragraph.

2.13 URINALS

A. Urinals:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan (Urinals/Flush Valve combo)
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: Siphon jet.
 - b. Design Consumption: 0.5 gal./flush (unless noted otherwise on drawings or within Schedule).
 - c. Color: White.
 - d. Supply Spud Size: NPS 3/4.
 - e. Outlet Size: NPS 2.

2.14 LAVATORIES

- A. Lavatories:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With back Ledge back Shelf back Slab Pedestal.
 - b. Faucet Hole Punching: Coordinate with faucet.
 - c. Color: White.
 - d. Supplies: NPS 3/8 chrome-plated copper with stops.
 - e. Drain: Grid.
 - f. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass 17-ga. P-trap; NPS 1-1/4 0.045-inch thick tubular brass waste to wall (trap arm); and wall escutcheon.

2.15 COMMERCIAL SINKS

- A. Commercial Sinks:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 2. Description: Counter-mounting, seamless commercial sink, self-rimming, fully undercoated for sound attenuation, with 1-3/4" radius coved corners.
 - a. Metal: 304 stainless steel, 18 gauge.
 - b. Finish: Satin.
 - c. Drain: 3" Grid, chrome-plated brass, with vandal resistant strainer and NPS 1-1/2 tailpiece; unless otherwise indicated.
 - d. Supplies: NPS 1/2 chrome-plated copper with stops.
 - e. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch- thick tubular brass waste to wall (trap arm); and wall escutcheon(s).

2.16 KITCHEN SINKS

- A. Kitchen Sinks, Barrier Free:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. Kohler Co.
 - b. American Standard Companies, Inc.
 2. Description: Two-compartment (high/low), accessible, built into counter, enameled, cast-iron kitchen sink.
 - a. Overall Dimensions:
 - b. Metal Thickness: 0.038 inch 0.050 inch.
 - c. Left Compartment:
 - 1) Dimensions: 7 x 9-inches.
 - 2) Drain: 3-1/2-inch outlet for disposer.
 - a) Location: Near back of compartment.
 - d. Right Compartment:
 - 1) Dimensions: 21 x 16-inches.
 - 2) Drain: 3-1/2-inch crumb cup.
 - a) Location: Near back of compartment on left side.
 - e. Supplies: NPS 1/2 chrome-plated copper with stops.

- f. Drain Piping: Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch thick tubular brass waste to wall (trap arm); and wall escutcheon(s).
- g. Color: White.
- h. Barrier-free Shroud: Required.
- i. Disposer: Required for left compartment.
- j. Dishwasher Air-Gap Fitting: Required.

2.17 SERVICE BASINS

- A. Service Basins:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule" or a comparable product by one of the following: (unless noted otherwise on drawings or within Schedule).
 - a. Crane Plumbing, L.L.C./Fiat Products.
 - b. Stern-Williams Co., Inc.
 - 2. Description: Flush-to-wall, floor-mounting, pre-cast terrazzo fixture with rim guard.
 - a. Rim Guard: On front surfaces, stainless steel.
 - b. Faucet: As indicated on drawing "Plumbing Fixture Schedule."
 - c. Color: Not applicable.
 - d. Drain: Cast-brass with nickel-bronze grid and NPS 3 (DN 80) outlet; extra heavy-duty, cast iron, deep seal trap.

2.18 UTILITY BOXES

- A. Utility Boxes, Clothes Washer:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule."
 - 2. Description: Flush mounted in wall cavity with shutoff valves.
 - a. Material: Galvanized Steel.
 - b. Finish: Unpainted.
 - c. Valves: Bronze, brass stem, compression.
 - d. Outlets: 3/4" Hose Thread.
 - e. Inlet Size: NPS 1/2, female thread.
 - f. Supplies: 60-inch Heavy-duty CW and HW clothes washer hoses, manufactured by Floodcheck (no exceptions). Provide with shock arrestors equal to Precision Plumbing Products #WHA-500L.
- B. Utility Boxes, Ice Maker:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed on the drawing "Plumbing Fixture Schedule."
 - 2. Description: Flush mounted in wall cavity with angle stop.
 - a. Material: Galvanized Steel.
 - b. Finish: Unpainted.
 - c. Supply: Annealed copper tube, minimum 48-inch length (coiled) to permit pulling out appliance for rear service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. All wall mounted fixtures and equipment shall be installed with floor mounted carriers (provided by Manufacturer).
- D. Install wall-mounted fixtures AT ELEVATIONS INDICATED ON ARCHITECTURAL DRAWINGS.
- E. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- F. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- G. Install wall-mounting fixtures with tubular waste piping attached to supports.
- H. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- I. Install counter-mounting fixtures in and attached to casework.
- J. Install fixtures level and plumb according to roughing-in drawings.
- K. 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 valve, if supply stops are not specified with fixture. Valves are specified in Specification Section "General-Duty Valves for Plumbing Piping."
- L. All appurtenances supporting fixtures to be chrome plated in exposed areas (including but not limited to under-cabinet areas).
- M. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- N. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- O. 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.
- P. Install toilet seats on water closets.
- Q. 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.
- R. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- S. 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.
- T. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- U. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- V. Install disposer in outlet of each sink indicated to have disposer. Install a labeled switch where indicated or in wall adjacent to sink if location is not indicated.
- W. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.
- X. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding

- fittings. Escutcheons are specified in Specification Section "Basic Mechanical Materials and Methods."
- Y. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Specification Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other plumbing specification sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures and appliances with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Specification Section "Grounding and Bonding."
- D. Connect wiring according to Specification Section "Conductors and Cables."
- E. Arrange for electric-power connections to fixtures, transformers and devices that require power. Electric power is specified in Electrical Specification Sections.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.
- F. Run hot water (full flow) at each faucet until temperature is stable (-2 degree deviation from water heater set point); balance manual (y-type, etcetera) mixing valve at each faucet to 110 F spout-discharge temperature.
- G. After compression cartridges are well-seated (50-60 cycles), adjust faucet wrist-blade handles to position parallel to back-splash (or wall that lavatory is mounted to) when fully closed (tight).

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 0005
MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove or Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner cleaned, packaged, and ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.
 - 1. Coordinate with Owner's representative, who will establish special procedures for removal and salvage.

1.4 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services (including but not limited to: Gas, Water, Fire Suppression, Chilled Water, Hot Water, Air Conditioning, etc).
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 5. Means of protection for items to remain and items in path of waste removal from building.
- B. Inventory: After selective demolition is complete, submit a list of items that have been salvaged.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/ Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Arrange to shut off indicated utilities with utility companies.
 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Contractor shall terminate demolished pipe and/or ductwork. System shall be capped and insulated per new work specification.
- F. Contractor shall remove any abandoned piping and/or ductwork in area of construction during the demolition process.
- G. Unforeseen Conditions
 1. Any unforeseen utilities found during construction that directly affect any trade must be brought to the engineer's attention via RFI.
 2. All existing conditions must be clearly annotated on the As-Built drawings.
- H. Repair any walls, floors or roofs that piping, ducts or equipment have been removed from (or through). Patch with similar materials to match finish and color (paint to match). If paint cannot be matched, repaint entire wall or surface.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 23 0100
SPECIAL CONDITIONS FOR ALL MECHANICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section covers the general provisions of the mechanical specifications applicable to the following systems:
 1. Heating, air conditioning, and ventilation.
- B. The use of the word mechanical in the body of the various specifications sections shall be interpreted to include all the aspects of all of the systems referenced in Mechanical Specifications.

1.2 DRAWINGS

- A. These specifications are accompanied by drawings of the building and details of the installations showing the locations of equipment, piping, ductwork, etc. The drawings and these specifications are complementary to each other; requirements described in one or the other shall be considered binding as if described in both.
- B. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Owner's Representative for approval. No departures shall be made without prior written approval by the Owner's Representative.
- C. There are intricacies of construction which are impractical to specify or indicate in detail; means and methods for performing such work shall adhere to commonly accepted industry standards.
- D. It is the Contractor's responsibility to properly use all information found on the Architectural, Structural, Mechanical, and Electrical drawings and applicable shop drawings where such information affects his work.
- E. For new buildings, all final dimensions shall be scaled from the Architectural drawings, unless otherwise noted. For work associated with existing buildings (renovations and additions), all final dimensions shall be field verified.

1.3 CONSTRUCTION REQUIREMENTS

- A. The architectural, civil, structural, electrical, plumbing, fire protection and mechanical drawings, and specifications are all part of the Contract Documents. In many instances there are details described on another trade's drawings that are not necessarily included or referenced in the mechanical drawings. It is the Contractor's responsibility to review in detail all parts of the Contract Documents prior to submitting a bid. Failure to comply with this requirement shall not relieve the Contractor of responsibility or be used as cause for additional compensation because architectural, structural, or electrical details were not included in the mechanical drawings.
- B. It is the intent of the Contract Documents to provide complete and fully functional installation in every respect. Material and/or construction details not specifically described in the Contract Documents, but commonly considered incidental to the industry, are required by the Contractor.
- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to comply with Codes, to facilitate the work of other trades, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated satisfactory operating installation.
- D. The mechanical, electrical and plumbing drawings are schematic in nature and do not show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of ordinances and structural and architectural conditions.

- E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid compromising structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to building lines unless otherwise noted.
- F. When the mechanical drawings do not give exact details as to the elevation of pipe or ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping, exposed conduit, and duct systems are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The plans do not show all required offsets, control lines, pilot lines, and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain to insulate will not be permitted.
- G. Final placement of serviceable equipment shall be carefully coordinated with all other trades to ensure sufficient clearance for maintenance according to manufacturer's recommendations. Lubricating orifices and adjustable components shall be easily accessible. Piping, conduit, valve stems, cabling and other building systems shall not interfere with service space.
- H. Location of Exposed Devices
 - 1. All exposed devices (grills, registers, diffusers, sprinkler heads, medical gas outlets, plumbing rough-ins, lights, outlets, communication devices, etcetera) shall be referenced to fixed data points that are coordinated with all trades; shall be located to present symmetrical arrangements with respect to the fixed data point; and shall facilitate the proper arrangements of acoustical ceiling tiles. Fixed data points shall include such features as wall and ceiling lines, soffits, balanced border widths, masonry joints, etc. Devices located in acoustical ceiling tiles shall occur symmetrically in tile joints or in the centers of whole tiles. The final determination of the exact location of each outlet and the arrangements to be followed shall be acceptable to the Owner's Representative.
 - 2. The drawings schematically indicate locations of the exposed devices. Final locations shall be determined by carefully coordinating the drawings pertaining to each trade. Where conflicts are identified, Owner's Representative shall determine final location. The Owner reserves the right to make any reasonable change in location of any device before installation, without additional cost.

1.4 QUALIFICATIONS

- A. Contractor must have minimum of five years experience installing commercial heating, ventilation and air conditioning systems, plumbing and piping systems similar to those described in these Contract Documents.
- B. Contractor must be licensed and hold a current contracting license that has been valid for a minimum of five years in the State of Texas.
- C. Contractor must be able to bond work for payment and performance of work being bid. Contractor's bonding agency shall have a Best's insurance rating of A or A+.

1.5 MATERIAL AND EQUIPMENT REQUIREMENTS

- A. Manufacturer's Instructions: The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner's Representative in writing of any conflict between the requirements of the Contract Documents

- and the manufacturer's direction and shall obtain the clarification of the Owner's Representative before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such clarification by the Owner's Representative, he shall bear all costs arising in connection with the correction of the deficiencies.
- B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage and from surrounding work.
 - C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
 - D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., ETL listed or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc. or ETL applied to the item will be acceptable as sufficient evidence that the items conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.
 - E. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and model-identification number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
 - F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
 - G. Protection from Moving Parts: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.
 - H. Drive Guards: For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling units casings. Guards shall be constructed of sheet steel, cast iron, expanded metal, or wire mesh rigidly secured so as to be removable without disassembling pipe duct or electrical connection to equipment. Provide a 1-inch diameter hole in each drive guard at each shaft center to allow access for speed measurement.
 - I. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner's Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, Architect, or Engineer.
 - J. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to

these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

- K. Spare Parts Data: As soon as practicable after approval of materials and equipment and, if possible, not later than four months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and sources of supply, a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified hereinafter to be furnished as part of the Contract, and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 120 days at the particular installation. The foregoing shall not relieve the Contractor of any responsibilities under the warranty specified.

1.6 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, structures, utilities, equipment, systems, facilities, and local requirements. The submission of bids shall be deemed evidence of such visits. All proposals shall take these existing conditions into consideration, and the lack of specific information shall not relieve the Contractor of any responsibility.

1.7 UTILITY LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered separately from the Contract Documents, as a general guide only, without guarantee as to accuracy. Examine the site, the locations, and availability of all utilities and services required for their relation to the work. Verify the location of all existing site utilities with each responsible utility company or applicable party. The Contractor shall repair all damage to existing utilities, whether indicated on the drawings or not, at his sole expense.

1.8 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

- A. Permitting Fees: Contractor shall pay for all fees associated with permits required by municipal authorities having jurisdiction.
- B. Tapping and Impact Fees: Contractor shall pay for all fees associated with tapping into municipal utility mains, including sanitary sewer, natural gas and domestic water. Impact fees will be paid for by the Owner.
- C. Compliance: The Contractor shall comply in every respect with all requirements of local authorities having jurisdiction, including building inspections, fire marshal, local ordinances and codes, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of a higher quality than the requirements of the above-specified authorities. Where requirements of the specifications and drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities.
- D. Utilities: The Contractor shall coordinate with the various utility companies involved in this project and shall provide required utility relocations, extensions, modifications, and/or changes (complete in all respects) as described in the Contract Documents. Contractor shall verify the location of all existing utilities with the applicable Utility Company. The Contractor shall be responsible for all damages to existing utilities, whether indicated on drawings or not, and repair all damage to existing utilities as acceptable to the affected Utility Company.
- E. Certification: Prior to final acceptance, the Contractor shall furnish a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract. Any additional labor costs incurred as a result of a substitution shall be the Contractor's responsibility.

1.9 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being performed under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc. to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

1.10 DEMOLITION AND RELOCATION

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum

interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. No substitution of materials or equipment herein specified or called for on the drawings will be permitted, except by written permission of the Owner's Representative. Where several makes of equipment or material are mentioned, any item named may be bid upon provided it meets space, capacity specifications, and other requirements.

1.12 SUBMITTALS

- A. Submittals for Review:
 1. As soon as practical or within 30 days after the date of contract award or notice to proceed, and before purchasing or starting installation of any materials or equipment, the Contractor shall submit for review sufficient material and equipment data to indicate that all requirements of the specifications have been met and samples shall be furnished when requested. All manufacturer's data used as part of the submittal shall have all non-applicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished.
 2. Four (4) copies of the submittal list and detailed submittals (for the Owner's and A/E's use) shall be submitted to the Owner's Representative. The Contractor is requested to include a minimum of three (3) additional copies for insertion in the project's Owner's Manuals at the completion of the project, and the number of additional copies the Contractor requires for his and his subcontractor's use during the project's construction. The detailed submittals shall be accompanied by the same number of sets of pictorial and descriptive data derived from the manufacturer's catalogs and sales literature or incorporated in the shop drawings. The Contractor may provide a detailed submittal on any item even though not required by the Owner's Representative.
- B. Format
 1. Submittals shall be in pdf format. The first page shall have a cover sheet inserted with the title "MECHANICAL SUBMITTALS" centered in large print. Below the title shall be printed the name of the project, the date, the project location, the name and address of the contractor, the name and address of the subcontractor and the name and address of the engineer(s) in smaller print.
 2. Provide a Table of Contents at the beginning of the binder that summarizes the information being submitted according to specification section.
 3. Submittals shall be tab divided by specification section; **all sections** identified in the project specifications shall have a tab. When no information is being provided concerning a particular specification section, insert a single dated sheet that explains the circumstances.
 4. **Loose-leaf or piecemeal submittals are not acceptable and subject to rejection unless prior approval has been granted by the Engineer.**
- C. Content:
 1. The Contractor shall prepare or cause to be prepared shop drawings, product data, materials and equipment lists, diagrams, data, samples, and other submittals as required by the contract documents, hereinafter referred to as "Submittal Data." The Contractor shall review and approve all submittal data for compliance with the contract documents, manufacturer's recommendations, adequacy, clearances, code compliance, safety, and coordination with associated work.
 2. The Contractor shall submit approved submittal data to the Owner's Representative for review and comment as to general conformance with the design concept and general compliance with information given in the contract documents. Owner's Representative's review shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with other trades or

work, or construction safety and precautions, all of which are the sole responsibility of the Contractor.

3. The Contractor shall clearly and specifically identify and call to the attention of the Owner's Representative any deviation from the contract documents for which Owner acceptance is desired. The responsibility for such a deviation accepted by the Owner shall remain with the Contractor.
4. Timeliness: The burden of timeliness in the complete cycle of submittal data is on the Contractor. The Contractor shall allow a minimum of four (4) weeks' time frame for review of each submission by the Owner's Representative. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submission cycles on nonconforming materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not justify any request for scheduled construction time extensions or extra compensation.
5. Work performed in accordance with approved submittal date that is not in accordance with the Contract Documents and did not have the specific acceptance of the Owner's Representative shall be replaced at Contractor's cost.

D. Re-submittals

1. Re-submit entire submittal in accordance with afore mentioned format and content requirements. **Loose-leaf or piecemeal re-submittals are not acceptable.** New and/or revised data for each section shall be prefaced with a colored (yellow, pink, orange, etc) cover sheet that identifies (in a word or two) the materials and/or equipment being re-submitted. Typeset the words "REVISED SUBMITTAL NO. 1 (or 2, 3 as applicable)" centered at the bottom of the cover sheet.
2. Subsequent re-submittals (second and third, if necessary) shall have different colored cover sheets to distinguish between the various re-submittals.
3. Include a cover letter at front of binder that specifically responds to each "REVISE AND RE-SUBMIT COMMENT" or "REJECTED" comment by number. Example responses would include the following:
 - a. RESPONSE: "Please see attached re-submittal."
 - b. RESPONSE: "Will be re-submitted at a later date."
 - c. RESPONSE: "Requirement for (xxxxx) was deleted in Addendum No. 2."
 - d. RESPONSE: "Exception requested based on Section xx, Paragraph x.x.x."

- E. These paragraphs related to Mechanical submittal data supersede any conflicting requirements contained in Division 01 sections.

1.13 CONTRACTOR CERTIFICATION OF SUBMITTAL DATA

- A. The Contractor shall provide the following certification with all submittal data furnished to the Owner's Representative for review and comment.

Project Title:

Description of Submittal Data:

This is to certify that the above-described submittal data has been reviewed and is approved for compliance with the Contract Documents, manufacturer's recommendation, adequacy, clearances, code compliance, safety, and coordination with other trades and/or work except as follows: (list "none" or itemize and explain). In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

Name and Company

1.14 ACCEPTANCE OF MATERIALS AND EQUIPMENT

- A. All equipment installed on this project shall have **local (within 125 miles)** representation, local factory-authorized service, and a local stock of repair parts. This requirement is essential and will be strictly reviewed by the Owner's Representative prior to concurrence with the Contractor's approval for all submittals covered by Mechanical sections of this Specification.
- B. NOTICE: The Contractor is responsible for providing materials and equipment that conform to the requirements of the project manual in every respect unless a deviation has been "accepted" in writing. Removal of any nonconforming materials and equipment and the replacement with conforming materials and equipment shall be at the Contractor's sole expense, regardless of when nonconformance was discovered.
- C. Approval of materials and equipment shall be based on manufacturer's published data and shall be tentatively subject to the submission of complete shop drawings which comply with the contract documents. Approval is also dependent upon the existence of adequate and acceptable clearances for entry, servicing, and maintenance.
- D. Approval of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Owner's Representative has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- E. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of approved manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

1.15 SHOP DRAWINGS

- A. As soon as practicable after the award of contract and approval of materials and equipment, but prior to installation, complete and detailed shop drawings of the following shall be submitted for review and comment:
 1. Equipment arrangements.
 2. Duct layouts.
 3. Piping layouts.
 4. Layouts of equipment spaces indicating ductwork and piping larger than 2 inches.
 5. Typical fittings and connections.
 6. Equipment foundations.
 7. Factory-fabricated equipment and materials.
 8. Anchors.
 9. Control.
 10. Interlock.
 11. Sprinkler locations.
 12. Other details as directed by the Owner's Representative. Composite drawings of areas requiring coordination between trades shall be provided and expedited to eliminate conflicts and to ensure maximum cooperation and work progress.
- B. Work performed without benefit of reviewed and approved shop drawings **will not be recommended for payment by the Engineer** until such time as the shop drawings are submitted, reviewed, and approved. Any work performed without the benefit of reviewed and approved shop drawings may require removal, relocation, and/or replacement at the Contractor's sole expense in order to resolve conflicts between the various systems and provide the performance specified.
- C. All installation of equipment, fixtures, terminal devices, etc. shall be made in accordance with approved composite shop drawings. The Contractor shall modify installation and relocate

- installed work to provide code clearances, service access, and eliminate conflict with other systems.
- D. Submit one print of shop drawings for each area, floor, system, etc. The print will be marked with the A/E's comments and returned to the Contractor. Contractor shall revise shop drawings, incorporate revisions in field and submit revised shop drawings at project close out.

1.16 SITE OBSERVATION

- A. Site observation by the Architect, Engineer, and/or Owner's Representative is for the express purpose of verifying compliance by the Contractor with the contract documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.17 SUPERVISION

- A. In addition to the Superintendent required under the conditions of the contract, each subcontractor shall keep a competent superintendent or foreman on the job at all times.
- B. It shall be the responsibility of each superintendent to study all plans and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and, before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the jobsite by the superintendents involved. Where interferences cannot be resolved without major changes to the plans, the matter shall be referred to the Owner's Representative for comments.

1.18 OPERATION PRIOR TO COMPLETION

- A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation and has the written permission of the Owner's Representative to do so. The warranty period shall not commence, however, until such time as the equipment is operated for the beneficial use of the Owner or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

1.19 MANUFACTURER'S RECOMMENDATIONS

- A. The manufacturer's published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Owner's Representative, in writing, of any conflict between the requirements of the contract documents and the manufacturer's directions, and shall obtain the Owner's Representative's comments before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or applicable comments from the Owner's Representative, he shall bear all costs arising in connection with the correction of such deficiencies.

1.20 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Before final acceptance of the work, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

- B. Check inspections shall include plumbing, heating, air conditioning, ventilating, mechanical control and electrical equipment, and such other items hereinafter specified or specifically designated by the Owner's Representative.

1.21 OPERATING AND MAINTENANCE INSTRUCTION

- A. The Contractor shall prepare for the owner's manual hereinafter specified complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc. for each item of equipment. These are to be assembled as hereinafter specified for owner's manual.
- B. In addition, the Contractor shall provide the service of a competent engineer or a technician acceptable to the Owner's Representative to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of sufficient duration to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, acknowledged by the Owner, stating the dates of instruction and personnel to whom instructions were given.
- C. Additional diagrams, operating instructions, etc. shall be provided as specified hereinafter in the other sections of these specifications.

1.22 MATERIAL AND EQUIPMENT SCHEDULES

- A. Contractor shall refer to both drawings and specification for schedules. Where reference is made to items "scheduled on drawings" or "scheduled in specifications," same shall include schedules contained in both the drawings and the specifications. The Contractor's attention is directed to the various specification sections and drawings for schedules.

1.23 APPLICABLE CODES AND STANDARDS

- A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications, except as may be hereinafter specifically modified in these specifications and associated drawings.
 - 1. National Fire Protection Association Standards (NFPA):
 - NFPA 10 - Portable Fire Extinguishers
 - NFPA 54 - National Fuel and Gas Code
 - NFPA 70 - National Electrical Code
 - NFPA 90A - Air Conditioning Systems
 - NFPA 101 - Life Safety Code
 - NFPA 255 - Method of Test of Surface Burning Characteristics of Building Materials
 - 2. American National Standards Institute (ANSI):
 - 15-78 - Safety Code for Mechanical Refrigeration
 - C.2 - 1984 National Electrical Safety Code
 - A117.1 - Handicapped Code
 - 3. American Society of Mechanical Engineers (ASME): Section IV, V, CSD-1
 - 4. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these specifications.
 - 5. American Water Works Association (AWWA): All applicable manuals and standards.
 - 6. Sheet Metal and Air Conditioning Contractors National Associate, Inc, (SMACNA): All applicable manuals and standards.
 - 7. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.
 - 8. American Society of Testing Materials (ASTM): All applicable manuals and standards.
 - 9. National Electrical Manufacturers' Association (NEMA): All applicable manuals and standards.
 - 10. Occupational Safety and Health ACT (OSHA):
 - National Sanitation Foundation - Standard No. 2
 - 11. American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE):

ASHRAE 90.1

12. Americans with Disabilities Act, 1990
 13. American Gas Association (AGA)
 14. Underwriters Laboratories, Inc. (UL)
 15. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS)
 16. Applicable Local and State Building Codes (International Building Codes, as amended):
 17. Applicable Local and State Mechanical Code (International Mechanical Code, as amended).
 18. Applicable Local and State Plumbing Code (International Plumbing Code, as amended).
 19. Applicable Local and State Energy Code (International Energy Conservation Code, as amended).
 20. Applicable State Gas Code (International Fuel and Gas Code, as amended).
- B. All materials and workmanship shall comply with all applicable city, state, and national codes, specifications, and industry standards. All materials shall be listed by the Underwriters Laboratories, Inc. as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.
- C. The contract documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Owner's Representative in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these contract documents, providing no work or fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules, and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.24 DEFINITIONS

- A. Refer to the condition of the contract for Division 1 for additional requirements regarding definitions.
- B. Where "as required" or "as necessary" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the Contractor certain coordination requirements in performing the work described or indicated. These coordination requirements entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
- C. Where "and/or" is used in these specifications or on the drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor."

1.25 FINAL INSPECTION

- A. Refer to Division 1 for additional requirements for final inspection.
- B. It shall be the responsibility of the Contractor to personally conduct a careful inspection, assuring himself that the work on the project is ready for final acceptance and developing his own "punchlists," before calling upon the Owner's Representative to make a final inspection. Failure of the Contractor to conduct such inspections and provide the Owner's Representative with a copy of his "punchlists" prior to the final inspection shall be adequate cause for the Owner's Representative to cancel any Contractor-requested final inspection.

C. In order not to delay final acceptance of the work, the Contractor shall conduct his own "final inspections" prior to requesting the Owner's Representative to "final" the project; will have all necessary bonds, guarantees, receipts, affidavits, etc. called for in the various articles of this specification prepared and signed in advance; and together with a letter of transmittal listing each paper included, shall deliver the same to the Owner's Representative at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc. before preparing same for submission to see that the terms check with the requirements of the specifications.

D. The final inspection will be made jointly by the Owner's Representative and the Owner.

1.26 REQUIREMENTS FOR FINAL ACCEPTANCE

- A. Requirements for final acceptance shall include but not be limited to the Contractor accomplishing the following:
1. Construction: Complete all construction.
 2. Deficiency Lists: Correct all deficiencies listed at time of Substantial Completion.
 3. Owner's Manual: Submit at least 30 days prior to final acceptance on (1) copy of the owner's manual for the Owner's Representative's review and comments. Following acceptance, prepare three (3) copies of bound and indexed owner's manual, to be delivered at the time of final acceptance, which shall include but not be limited to the following:
 - a. System operating instructions.
 - b. System control drawings.
 - c. System interlock drawings.
 - d. System maintenance instructions.
 - e. Manufacturers', suppliers', and subcontractors' names, addresses, and telephone numbers, both local representatives and manufacturers' service headquarters.
 - f. Equipment operating and maintenance instructions and parts lists.
 - g. Manufacturer's certifications (see Checking and Testing Materials and/or Equipment, this section).
 - h. Contractor's warranty.
 - i. Acceptance certificates of authorities having jurisdiction.
 - j. Log of all tests made during course of work.
 - k. Owner's acknowledgment of receipt of instruction, enumerating items in owner's manual.
 - l. List of manufacturers' guarantees executed by the Contractor.
 - m. Certified performance curves.
 - n. Balance and performance test reports.
 - o. Owner's acknowledgment of items of equipment or accessories indicated or specified to be turned over to Owner.
 4. Instructions:
 - a. Verbal, as herein specified.
 - b. Posted, framed under glass or plastic laminated:
 - 1) System operating instructions.
 - 2) System control drawings.
 - 3) System interlock drawings.
 5. Record Drawings: Deliver the specified record drawings to the Owner's Representative.

1.27 RECORD DRAWINGS

- A. The Contractor shall maintain a set of contract drawings (black-line prints) at the jobsite on which he shall indicate the installed (as-built) locations of the following:
1. Equipment
 2. Main lines of piping and ductwork.

3. Dimensional locations (including depth) of all underground piping, valves and conduits.
- B. Drawings shall be used for construction reference and shall not leave the field office of the jobsite.
- C. Drawings shall include all addenda, ASI's, Change Orders, and existing conditions and equipment that are not reflected in the original contract drawings.
- D. Upon completion of work, the Contractor shall obtain CAD files of the contract drawings from the Owner's Representative and transfer the above as-built information into these files. The as-built files shall be permanently marked "RECORD DRAWINGS" and printed on full-size Mylar sheets. Upon completion, the CAD files shall be transferred to CD in AutoCAD 2007 format. Both the CAD files CD and Mylar drawings shall be submitted to the Owner's Representative as part of the Close-out Submittals.
- E. Refer to Division 1 paragraph entitled "Record Documents" for additional requirements.

1.28 ALLOWANCES

- A. Refer to Division 1 for allowances.

1.29 ALTERNATE PROPOSALS

- A. Alternate proposals are summarized in Division 1 and on the bid proposal form. Refer to all sections of the specifications and the drawings to determine the exact extent and scope of the various alternate proposals as each pertains to the work of the various trades.

1.30 WARRANTY

- A. General: All work performed (including equipment and materials furnished) under the various sections of these specifications shall be 100% warranted, for a period of one (1) year from the date of final acceptance thereof, against defective materials, design, and unauthorized substitution. Upon receipt of note of failure of any part of the guaranteed equipment and/or facilities during the guaranty period, the affected part(s) or facilities shall be replaced promptly with new parts, etc. by and at the expense of the Contractor. Further, the Contractor shall properly obtain, execute, and forward any and all manufacturer's warranties on equipment furnished under the Contract. Refer to Division 1 for additional requirements.
- B. Extended Period: The Contractor shall provide all extended time warranties available from the manufacturer of the equipment provided as standard at no additional cost. This includes all extended warranties where specified with certain equipment as directed in other sections of this Specification.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be current United States manufacture, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, precise appearance.
- C. The responsibility for the furnishing and installation of the proper mechanical equipment and/or material as intended rests entirely upon the Contractor. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

- A. Duct coverings, duct linings, vapor barrier facings, tapes, adhesives, core materials, insulation, jackets, piping (of any sort), and other materials in concealed locations, including any above-ceiling area, shall have a flame spread rating not over 25 without evidence of

continued progressive combustion and a smoke developed rating no higher than 50. Flame spread and smoke developed ratings shall be in accordance with NFPA Standard No. 255.

2.3 BEARINGS

- A. All ball bearings shall be of radial and/or thrust type and enclosed in a dust and moisture-proof housing.

2.4 MOTORS

- A. The Contractor shall provide all motors required for equipment supplied under each portion of the work. Motors shall be premium efficiency and be built in accordance with the latest ANSI, IEE, and NEMA standards, shall be fully coordinated with the equipment served, shall be of sizes and electrical characteristics scheduled.

2.5 STARTING EQUIPMENT

- A. Each motor shall be provided with proper starting equipment. This equipment, unless hereinafter specified or scheduled to the contrary, shall be provided by the trade furnishing the motor. All motor starting equipment provided by any one trade shall be of the same manufacture unless such starting equipment is an integral part of the equipment on which the motor is mounted.

2.6 LOW VOLTAGE (CONTROLS/THERMOSTAT) WIRING

- A. All low voltage wiring installed by the Mechanical Contractor, Electrical Contractor or Controls Vendor shall be run in a neat and workmen like manner, parallel and perpendicular to building lines on J-Hooks (above ceiling grid only). Plenum rated cable shall be installed above ceilings. All other locations (exposed, Mechanical Rooms, outdoors or above hard lid ceiling) should be installed in conduit.

2.7 SLEEVES, INSERTS, AND FASTENINGS

- A. General: Proper openings through floors, walls, roofs, etc. for the passage of piping, ductwork, conduits, etc. shall be provided. All piping and conduit through floors and piping through walls must pass through sleeves except soil pipe installed under concrete slabs-on-fill, and pipe and conduit that is cast-in-place. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Owner's Representative.
- B. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches 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.
- C. 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.
- D. Sleeves: The minimum clearance between horizontal pipe, including insulation where applicable, and sleeve shall be 1/4 inch, except that the minimum clearance shall be 2 inches where piping contacts the ground. Sleeves through floors shall extend 3/4 inch above the floor; sleeves through walls and partitions shall be installed flush with exposed surfaces.
- E. Materials: Install sleeves large enough to provide $\frac{1}{4}$ " annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 1. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.

2. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - a) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
- F. Inserts: Suitable concrete inserts for pipe, conduit, and equipment hangers shall be set and properly located for all piping, conduit, and equipment to be suspended from concrete construction.
- G. Fasteners: Fastening of pipes, conduits, etc. in the building shall be as follows:
1. To wood members: by wood screws.
 2. To masonry and concrete: by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry or concrete.
 3. To steel: machine screws or welding (when specifically permitted or directed), or bolts.
- NOTE: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.**
- H. Ratproofing: The open space around all piping, ductwork, etc. passing through the ground floor and/or exterior walls shall be ratproofed in a manner acceptable to the Owner's Representative.
- I. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50% greater in diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor with a fire-resistant sealant.
- J. Air Plenums: The space around piping, ductwork, etc. passing through an air plenum shall be made airtight in a manner acceptable to the Owner's Representative. The sealant used must be fire resistant.

2.8 FIRE AND SMOKE PARTITION, WALL, AND/OR FLOOR PENETRATIONS

- A. Pipe, ductwork, conduit, etc. shall pass through fire- or smoke-rated floors, partitions, walls, or other barriers within a UL-listed assembly which shall maintain the rating of the applicable wall, floor, partition, or barrier.
- B. The Contractor shall review the architectural and structural drawings and determine the location of the fire-rated building elements. Where these elements are penetrated, UL-listed fire-rated penetration assemblies approved by the local authority shall be provided in accordance with the manufacturer's instructions to obtain the required rating.

2.9 METAL BUILDING SYSTEMS/MECHANICAL-ELECTRICAL SUPPORTS

- A. Metal building systems are required to be designed by the manufacturer to accommodate and support the mechanical systems indicated on the mechanical drawings and specified in Mechanical specifications.
- B. The metal building systems manufacturer is required to provide the following:
 1. Framed openings through the roofs with supports, roof curbs, and flashings for roof-mounted equipment, fans, vents, and air intakes.
 2. Structural support for piping, conduits, and suspended equipment consisting of beam, joists, purlins, and/or blocking above and perpendicular to pipe routes and equipment hangers at intervals not to exceed 8 feet.
 3. Structural support for suspended ceilings, diffusers, grilles, light fixtures including associated raceways and ductwork.
- C. The mechanical trade shall:
 1. Provide all routes, weights, installation heights, opening locations, etc. for all equipment, piping, vents, etc. to the metal building system manufacturer and coordinate requirements for structural supports, hangers, attachments, etc. with the metal building systems manufacturer.

2. Provide all supporting devices (hangers, attachments, brackets, cross beams, etc.) to attach to the metal building structural system.

2.10 FOUNDATIONS / HOUSEKEEPING PADS

- A. General: All special foundations and supports required for the proper installation of equipment and pipe shall be provided as hereinafter specified and under the section of the specifications covering the equipment, unless otherwise indicated on the drawings.
- B. All mechanical equipment shall receive concrete housekeeping pads unless otherwise noted. Equipment to receive pads are to include (but not limited to): air handlers, fan-coils, condensing units, boilers, water heaters, water softeners, expansion / compression tanks, filter feeders, water treatment equipment, air compressors, fans, pumps (in addition to inertia bases where required), chillers, surge tanks, deareators, etc.
- C. Concrete foundations for the support of equipment such as floor-mounted pumps, fans, etc. shall be not less than 5½ inches high and not less than 4 inches larger (in both directions) than supported unit, unless otherwise noted and shall be poured in forms built of new dressed lumber. All corners of the foundations shall be neatly chamfered by means of sheet metal or triangular wood strips nailed to the form. Pads shall not be laid out directly against walls or structures. 2 inches shall be left available for pad form work. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Allow 1 inch below the equipment bases for alignment and grouting (where applicable). Foundations for equipment located on the exterior of the building shall be provided as indicated. Foundations shall be constructed in accordance with approved shop drawings and shall be reinforced with #4 bars at 12 inches on center both ways (minimum).
- D. Pipe and Conduit Support: All pipes and conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical pipes and conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.

2.11 ACCESS DOORS

- A. General: Provide access doors for all serviceable mechanical appurtenances (valves, trap primers, shock arresters, volume dampers, fire/smoke dampers, actuators, sensors, etcetera) in inaccessible locations. Such locations include gypsum, brick and CMU ceilings and walls.
- B. Location of panels shall be carefully coordinated with other Exposed Devices as described in earlier paragraphs.
- C. Manufacturers shall be Inland-Milcor, Bilco, Miami Carey, or approved equal. Unless indicated otherwise, use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.
- D. Minimum construction features include 14-gage frame and door, continuous hinges, cam-style latch and 10x10" unobstructed opening size.
- E. UL labeled when in fire-rated construction, one and one-half hour rating.
- F. Access doors located outside, in restrooms or in a moisture-laden environment (dressing area, shower area, lockers, etc.) shall be stainless steel construction.
- G. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. Doors shall be set flush with adjacent finish surfaces. Exterior doors shall be provided with cylinder locks.
- H. Access doors into ductwork shall be 14-gauge insulated galvanized steel with 16-gauge galvanized gasketed steel frame and cam-type locks. Ductwork access door shall be a minimum of 12" × 12" in size.

2.12 FLOOR AND CEILING PLATES

- A. Except as otherwise noted, provide one-piece chrome-plated brass floor and ceiling plates (or escutcheons) around all pipes, conduits, etc. passing through walls, floors, or ceilings in any spaces, except underfloor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the outside of insulation on lines which are insulated, and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend $\frac{3}{4}$ of an inch above finish floor and are concealed. Plates shall be one piece.

PART 3 - EXECUTION

3.1 SPACE AND EQUIPMENT ARRANGEMENT

- A. The size of mechanical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers will be acceptable, it is the responsibility of the Contractor to determine whether the equipment he proposes to furnish will fit in the space. Shop drawings shall be prepared when required by the Owner's Representative to indicate a suitable arrangement.
- B. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

3.2 LARGE APPARATUS

- A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

3.3 PROTECTION

- A. The Contractor shall take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. The Contractor shall protect existing facilities, the work of others, and the premises from any and all damages that may be made possible by the execution of work.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

3.4 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various trades, subcontractors, and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.
- B. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the jobsite in a clean and safe condition. At the end of each day's work, each trade shall properly store all of its tools, equipment, and materials and shall clean its debris from the job. Upon the completion of the job, each trade shall immediately remove all of its tools, equipment, any surplus materials, and all debris caused by its portion of the work.

3.5 PRECEDENCE OF MATERIALS AND COORINATION OF WORK

- A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each subcontractor and/or trade shall be responsible for the proper fitting of his material and apparatus into the building.
- B. The work of the various trades shall be performed in the most direct and workmanlike manner without hindering or handicapping the work of other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Where space requirements conflict, the following order or precedence shall, in general, be observed:
 1. Building lines.
 2. Structural members.
 3. Light fixtures.
 4. Soil and drain piping.
 5. Condensate drains.
 6. Vent piping.
 7. Supply, return, and outside air ductwork.
 8. Exhaust ductwork.
 9. HVAC water and steam piping.
 10. Steam condensate piping.
 11. Fire protection piping.
 12. Natural gas piping.
 13. Domestic water (cold and hot).
 14. Refrigerant piping.
 15. Electrical conduit.
- C. The light fixture grid layout as indicated on the drawings must be maintained. This Contractor shall refer to all light fixture plans and details indicated on the drawings and shall coordinate the location of dampers, supply grilles, return air grilles, sprinkler heads, etc. with the location of the light fixtures to assure proper access to all items in a manner acceptable to the Owner's Representative.
- D. The electrical trades shall locate all junction boxes, pull boxes, conduits, etc. to avoid interference with the diffusers, dampers, grilles, etc. hereinbefore mentioned. The mechanical trades shall furnish to all other trades copies of approved ductwork shop drawings to assist in the coordination of the rough-in and installation of all items of work.

3.6 CONNECTIONS FOR OTHERS

- A. This Contractor shall rough-in for and make all water, sewer, electrical, etc. connections to all fixtures, equipment, machinery, etc. provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, connectors, etc.
- C. Provide all air gap fittings required, using materials hereinbefore specified. In each water line serving an item of equipment or piece of machinery, provide a shutoff valve. On each drain without integral trap provide a suitable trap.
- D. All pipe fittings, valves, traps, etc. exposed in finished areas and connected to chrome-plated lines provided by others shall be chrome-plated to match.
- E. Provide all sheet metal ducts, transition pieces, etc. required for a complete installation of equipment provided by others.

3.7 INSTALLATION METHODS

- A. Where to Conceal: All pipes and conduits shall be concealed in pipe chases, walls, furred spaces, below suspended floors, or above the ceilings of the building unless otherwise indicated.
- B. Where to Expose: In mechanical rooms, janitor's closets tight against pan soffits in exposed Tee structures, or storage spaces, but only where necessary, piping and conduit may be run exposed. All exposed piping and conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. Support: All piping and conduit shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, rather than hung below them, in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Owner's Representative for each penetration.
- E. All pipe, conduits, etc. shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes, and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that they shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc. shall be similarly installed, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.
- F. Special Requirements:
 - 1. There shall be no pipe joints nearer than 12 inches to a wall, ceiling, or floor penetration unless pipe joint is a welded or mechanically-coupled-type joint.
 - 2. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Owner's Representative and resolve the conflict prior to erection of any work in the area involved.
 - 3. All piping not directly buried in the ground shall be considered as "interior piping."
 - 4. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangements can be made for an inspection of the above-ceiling area about to be "sealed off." The Contractor shall give as much advance notice as possible up to ten (10) working days, but in no case less than five (5) working days.
 - 5. The purpose of this inspection is to verify the completeness and quality of the installation of the air conditioning systems, the plumbing systems, and any other special above-ceiling systems such as pneumatic tube. The ceiling supports (tee bar or lath) should be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
 - 6. No ceiling material shall be installed until the deficiencies listed from this inspection have been corrected to the satisfaction of the Owner's Representative.

3.8 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc. resulting from work in existing construction or where made necessary by failure to provide proper openings or recesses in new construction.
- B. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner's Representative. Impact-type equipment will not be used except where specifically acceptable to the Owner's Representative. Openings in concrete for pipes, conduits, outlet boxes, etc.

- shall be core drilled to exact size. **Determine location of embedded conduit and reinforcing bars prior to cutting.**
- C. Restoration: All openings shall be restored to "as-new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
 - D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner's Representative.
 - E. Plaster: All mechanical work in area containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
 - F. Weakening: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.9 ROOF PENETRATIONS AND FLASHING

- A. Pipe and conduit ducts, pitch pockets, curb bases, and flashing compatible with the roofing installation shall be provided for roof penetrations. Provide framing or other support around all openings through roof as required to preserve the structural integrity of the roof system and make the penetration weathertight.
- B. Provide 30-inch round or square flashing acceptable to the roofing trades at all roof and deck drain and sleeve flashing locations.
- C. Roof curbs for all roofs except standing seam metal roofs shall be provided by the equipment supplier supplying the roof-mounted equipment, etc., and such curbs shall be installed by the roofing trades. Contractor shall coordinate all roof curb requirements with all trades and the roofing trades at the earliest possible stage of the project.
- D. Roof curbs for standing seam metal roofs shall be provided by the roofing trades. Curb base size, height, and type shall be coordinated with the roofing trades at the earliest possible stage of the project.
- E. Flashing for pipe and conduit penetrations of standing seam metal roofs shall be provided and installed by the roofing trades.

3.10 EXCAVATING AND BACKFILLING

- A. Perform trenching, excavating, backfilling for mechanical work as set forth below.
- B. Depth of excavation to provide a minimum of 3 feet above top of pipe. Excavation to be carried to a depth of at least 6 inches below bottom of pipe elevation. Fill below pipe (6 inches), around pipe, and a minimum of 12 inches above pipe with sand of Class "B" crushed stone tamped firm and even. Separate topsoil during excavation. Final layer of dirt (12 inches minimum) to be topsoil. Trenches to be at least 18 inches wider than pipe with batter boards placed every 25 feet. Backfilling shall be done to exclude use of rock or stone above sand or Class "B" crushed stone.

3.11 TESTS AND INSPECTIONS

- A. General: The Contractor shall make all tests deemed necessary by the inspection departments of the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel and electrical energy for system operational tests following beneficial occupancy by the Owner will be paid for by the Owner.
- B. Other: Additional tests specified hereinafter under the various specification sections shall be made.

- C. Notification: The Owner's Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Architect, Engineer, and/or Owner's Representative.
- D. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner's Representative as specified under "Requirements for Final Acceptance."
- E. Inspections: In general, an inspection by the Owner's Representative shall be required prior to closing up any work and prior to beneficial occupancy or final project completion. The closing up of work includes, but is not limited to, pipe and conduit installations prior to backfilling; mechanical, electrical, and fire protection work prior to placement of concrete; or closing up walls and overhead mechanical, electrical, and fire protection work prior to installation of the ceiling.

3.12 CLEANING AND PAINTING

- A. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- B. Exposed metal work which is not galvanized shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean and then painted with a suitable rust resistant primer. Exposed metal work includes work exterior to the building; exposed in mechanical or electrical equipment rooms and storage rooms; and other areas where occupants could see the work, whether normally occupied or not.
- C. All other painting shall be accomplished under the Painting Section of Division 9 of the specifications.

3.13 DISCHARGE OF WASTES FROM CONSTRUCTION SITE

- A. The Contractor shall comply with all applicable provisions of local, state, and federal laws regarding the discharge of wastes into sewer and waterways. Special caution shall be exercised to prevent the discharge of wastes which contain oil, tar, asphalt, roofing compound, kerosene, gasoline, paint, mud, cement, lime, or other materials which would degrade the water quality of the receiving water course. The Contractor shall construct and maintain oil interceptors, settling basins, acid neutralization tanks, and/or other effective pollution countermeasures, as required by the Texas Water Quality Board.

END OF SECTION

SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for mechanical system piping and equipment:
1. Steel pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Metal framing systems.
 4. Thermal-hanger shield inserts.
 5. Fastener systems.
 6. Equipment supports.
- B. Related Sections include the following:
1. Specification Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Specification Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL COATING REQUIREMENTS:

- A. All metal products shall have the following coatings:
 1. Wet/damp areas: hot dipped galvanized.
 2. Dry or conditioned areas: pre-galvanized.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 1. AAA Technology & Specialties Co., Inc.
 2. Bergen-Power Pipe Supports.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Carpenter & Paterson, Inc.
 5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pre-galvanized (minimum thickness of 0.5 mils) or hot dipped (1.4 to 3.9 mil thickness).
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.
 7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert with a sheet metal shield.
- B. Manufacturers:
 1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Buckaroos
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier. **Wood inserts are not acceptable.**
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. Insulation-Insert Material for Hot Piping only, up to 3" diameter: Molded fiberglass block, 20 lbs/ft³ density, thermal conductivity of 0.30.
- F. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- G. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- H. Insert Length: Extend 4 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars.
 1. Exterior: Galvanized steel.
 2. Interior: Black steel.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Thermal-Hanger Shield Inserts: For supporting insulated cold pipe. **Wood inserts are not acceptable.**
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments in concrete construction only in locations approved by the structural engineer.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure; **attaching to metal roof decks is not permissible.**
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Install suspended units on supports fabricated from welded-structural-steel shapes or from strut channels as applicable for the unit weight. Vertical support members must be appropriately sized threaded rods. Metal straps or cables are not allowed. Isolate units to prevent vibration or noise as specified in other sections.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads for NPS 2-1/2 and larger, including valves, flanges, and strainers, and at changes in direction of piping (24" maximum distance from elbow). Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install thermal-hanger shield inserts on insulated piping with vapor barrier. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- N. Insulated Ducts (Mineral Fiber Blanket). Comply with the following:

1. At all unistrut supports provide mineral fiber board insert in between ductwork and unistrut. Insert to extend 12" on both sides of unistrut, full length of strut. Extend blanket between structural insert.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for floor-mounted equipment to make a smooth bearing surface.
- C. Provide lateral bracing to prevent swaying for suspended equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, field cuts, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 0553
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
1. Equipment nameplates.
 2. Equipment markers.
 3. Equipment signs.
 4. Access panel and door markers.
 5. Pipe markers.
 6. Duct markers.
 7. Stencils.
 8. Valve tags.
 9. Valve schedules.
 10. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
B. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals. Reproduce on 8½ □ 11 bond. Tabulate valve number, piping system, system abbreviation as shown on tag, room or space location of valve, and variations for identification. Mark valves intended for emergency shutoff and similar special uses. Indicate normal operating positions (open, closed, modulating, or balance).

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 GENERAL

- A. Products specified are for applications referenced in other Mechanical sections. In addition to a factory installed equivalent nameplate, all equipment shall have an engraved equipment sign that matches the schedule tag name.

2.2 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.
 4. Material: Brass.
- B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/8 inch, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Manufacturers standard preprinted, semi-rigid, snap-on type.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 4. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
 5. Lettering: Manufacturers standard preprinted.

2.4 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. See Execution section for color scheme.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch thick aluminum.
 2. Valve-Tag Fasteners: Brass S-hook.
 3. Size: 1½ inches in diameter, unless otherwise indicated.

2.6 VALVE SCHEDULES

- A. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
- B. Frame: Extruded aluminum.
- C. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches **minimum**.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Mechanical Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent fasteners 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 for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-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. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. 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. Green and Yellow, Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 2. Letter Size: Minimum 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

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 and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. 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: Snap-on application of pretensioned, semi-rigid plastic pipe marker.
 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with manufacturer's stainless steel bands.
 3. Fasten Option: Laminated or bonded application of pipe marker to pipe or insulation.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; in machine rooms; in accessible maintenance spaces such as shafts, tunnels and plenums; and in exterior nonconcealed locations such as rooftops and chiller yards, 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 along each run. Reduce intervals to 25 feet **in** areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings.

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. Yellow: For hot-air supply ducts.
 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 5. Letter Size: Minimum 1/2 inch for name of units if viewing distance is less than 24 inches, 3/4 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system. Reduce intervals to 25 feet in areas of high duct congestion.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 VALVE TAGS

- A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.
- B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
- C. Tag Material: Aluminum.
- D. Tag Size and Shape: 1-1/2 inches, round.
- E. Tag Color: According to the following:
 1. Chilled Water: Blue.
 2. Cold Water: Black.
 3. Hot Water: Red.
 4. Fire Protection: Red.
 5. Sprinkler: White.
 6. Gas: Yellow.
 7. Steam: Red.
- F. Letter Color: White.
- G. Install mounted valve schedule in each major equipment room.

3.8 EQUIPMENT SIGNS AND MARKERS

- A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:
 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 2. Meters, gages, thermometers, and similar units.
 3. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 4. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 5. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 6. Fans, blowers, primary balancing dampers, and mixing boxes.
 7. Packaged HVAC central-station and zone-type units.
 8. Tanks and pressure vessels.
 9. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
 10. Any concealed appurtenances requiring access for maintenance shall be clearly identified by sign (to include but not be limited to unions, strainers, valves, etc.).
- B. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.
 1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.9 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work included in this section consists of the furnishing of all labor, instruments, tools, and services required in connection with the testing, adjusting and balancing (TAB) of the heating, ventilating, and air conditioning systems as described in the mechanical specifications and/or shown on the mechanical plans, or reasonable implied therefrom.
- B. TAB of the HVAC systems will be performed by an impartial technical firm that is a member of NEBB and whose operations are limited to the field of professional testing and balancing.
- C. Mechanical Contractor to obtain TAB services from an independent TAB contractor.
- D. Qualified TAB firms shall submit cost, scope of work, qualifications, time line, and references.
- E. The TAB firm is responsible to and shall submit five (5) copies of all reports directly to the Architect/Engineer and one copy to the Owner.
- F. TAB services shall result in the optimum temperature, airflow, and noise levels in the conditioned space of the project.
- G. The following basic components of the HVAC systems shall be tested, adjusted, and balanced:
 1. Air distribution systems.
 2. Air moving equipment.
 3. HVAC pumps (chilled water, hot water, condenser water, etc.).
 4. Heating systems (HVAC).
 5. Control systems verification.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 2. Adjusting total HVAC systems to provide indicated quantities.
 3. Measuring electrical performance of HVAC equipment.
 4. Setting quantitative performance of HVAC equipment.
 5. Verifying that automatic control devices are functioning properly.
 6. Measuring sound and vibration.
 7. 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. See all related HVAC mechanical sections.
 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. NEBB: National Environmental Balancing Bureau.
- N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. 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.
- E. Sample Report Forms: Submit 2 sets of sample testing, adjusting and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Guarantee" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. Contract Documents examination report.
 - c. Testing, adjusting, and balancing plan.

- d. Work schedule and Project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- 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 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. 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."
- F. Instrumentation Calibration: Calibrate instruments at least every 12 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 GUARANTEE

- A. General: 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 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.
- D. 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.
- E. 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.
- F. Examine system and equipment test reports.
- G. 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.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. 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.
- J. 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.
- K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine strainers for clean screens and proper perforations.
- M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. 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. The Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.

9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to design values.
- R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so design conditions for system operations can be met.
 9. Motors are wired properly with appropriate overloads and correct rotation.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. 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.
- B. 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.
- C. 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. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. 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.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.

3.5 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

- A. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at design flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

- A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated

- brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.
 - B. Set calibrated balancing valves, if installed, at calculated presettings.
 - C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 - D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.
 - E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
 1. Determine the balancing station with the highest percentage over design flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
 3. Record settings and mark balancing devices.
 - F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
 - G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 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.

3.11 BOILERS

- A. Measure entering- and leaving-water temperatures and water flow.

3.12 HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 1. Entering- and leaving-water temperatures.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperatures of entering and leaving air.
 5. Wet-bulb temperatures of entering and leaving air.
 6. Airflow.
 7. Air pressure drop.
- B. 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.

3.13 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.14 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. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.15 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans: -5 to plus 10 percent.
 2. Air Outlets and Inlets: \pm 10 percent.
 3. Heating-Water Flow Rate: \pm 10 percent.
 4. Cooling-Water Flow Rate: \pm 5 percent.

3.16 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

- C. Preliminary Report: Submit preliminary TAB reports to the design engineer for each floor, the central plant, and the chilled and hot water hydronic system.

3.17 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 Final Report Contents: In addition to the certified field report data, include the following:
1. Pump Curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but 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. Inlet vane settings for variable-air-volume, systems.
 - g. Settings for supply-air, static-pressure, controller.
 - h. 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.
 7. Locations of duct traverse(s) of duct layout.
- F. Air-Handling 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 and bore.
 - i. Sheave dimension, center-to-center and amount of adjustments in inches (mm).
 - j. Number of belts, make and size.
 - k. 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.
 - e. Sheave make, size in inches and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
 3. Test Data: Include design and actual values for the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
- G. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
 - a. System Identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch.
 - f. Make and model number.
 - g. Face area in sq.ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outside-air, wet and dry-bulb temperatures in deg F.
 - e. Return-air, wet and dry-bulb temperatures in deg F.
 - f. Entering-air, wet and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet and dry bulb temperatures in deg F.
 - h. Return-air, wet and dry-bulb temperatures in deg F.
 - i. Entering water temperature in deg F.
 - j. Leaving water temperature in deg F
 - k. Water flow rate in gpm.

- I. Water pressure differential in feet of head or psig.
- H. Water Chiller Test Reports: For chillers (Air Cooled or Water Cooled)
 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.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Volts, phase and hertz.
 - c. Full-load amperage and service factor.
 3. Test Data:
 - a. Total chilled water flow rate in gpm.
 - b. Total condenser water flow rate in gpm.
 - c. WPD in ft across chilled water.
 - d. WPD in ft across condenser water.
 - e. Chilled water supply and return temperatures °F.
 - f. Condenser water supply and return temperatures in °F.
- I. Cooling Tower Test Reports: For condenser water cooling tower:
 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.
 2. Motor Data (Fan or Pump): 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 condenser under flowrate in gpm.
 - b. Total wpd in ft across condenser water.
 - c. Condenser water supply and return temperatures in °F.
 - d. Fan rpm.
- J. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.

2. Test Data: Include design and actual values for the following:
 - a. Heat output in Btuh.
 - b. Airflow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- K. Fan Test Reports: For supply, return, and 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.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
 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. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data: Include the following:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Locate traverse location on duct work layout.
 - d. Traverse air temperature in deg F.
 - e. Duct static pressure in inches wg.
 - f. Duct size in inches.
 - g. Duct area in sq. ft.
 - h. Design airflow rate in cfm.
 - i. Design velocity in fpm.
 - j. Actual airflow rate in cfm.
 - k. Actual average velocity in fpm.
 - l. Barometric pressure in psig.
- M. Air-Terminal-Device Reports: For terminal units, include the following:
 1. Unit Data: Include the following:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.

- d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft.
2. Test Data: Include design and actual values for the following:
- a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- N. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data: Include the following:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data: Include design and actual values for the following:
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- O. Instrument Calibration Reports: For instrument calibration, include the following:
- 1. Report Data: Include the following:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION

SECTION 23 0719
MECHANICAL INSULATION

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes mechanical insulation for duct, equipment, and pipe, including the following:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Phenolic
 2. Adhesives.
 3. Mastics.
 4. Sealants.
 5. Factory-applied jackets.
 6. Field-applied fabric-reinforcing mesh.
 7. Field-applied tape.
 8. Field-applied jackets.
 9. Securements.
 10. Corner angles.
- B. Related Sections include the following:
1. Specification Section "Metal Ducts" for duct liners.
 2. Specification Section "Hangers and Supports" for high-density inserts at hangers; **wood inserts at hangers are not acceptable**.
 3. Specification Section "Special Conditions for All Mechanical Work".
 4. Specification Section "Basic Mechanical Materials and Methods".
- C. Not all items listed within this specification are used. Use only items applicable per application schedule.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. CONCEALED: Covered or concealed by a ceiling (gypsum or lay-in acoustical tile) or wall.
- C. EXPOSED: Open to view; not concealed by a ceiling or wall of any sort.
- D. FSK: Foil, scrim, kraft paper.
- E. UNDERFLOOR: Accessible crawl space beneath lowest floor level. (considered "outdoors")

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any). Provide submittal data on all products to be used.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E

84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. All products to be stored in a dry location, protected from the elements. All damaged insulation to be replaced.

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and high-density insulation inserts and shields specified in Specification Section "Hangers and Supports." Coordinate with drawing details where applicable; wood inserts at hangers are not acceptable.
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
- C. Insulation not to be installed until building is dried in.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Phenolic:
 - 1. Manufacturers:
 - a. Resolco
 - b. Dyplast Products
 - c. Polyguard
 - d. Approved equal.

2. 100% CFC-free, HCFC-free, and halogen-free, closed cell rigid phenolic foam insulation.
 3. Minimal thermal conductivity @ 75° F
 - a. Green, 2.5 lb/ft³: 0.15 (Btu.in/hr.ft². F)
 - b. Pink, 5.0 lb/ft³: 0.21 (Btu.in/hr.ft². F)
- G. Cellular Glass:
1. Manufacturers:
 - a. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 7. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Minimal thermal conductivity at 75° F of 0.27 (Btu.in/hr.ft². F) (R-value of 10.34@ 3 inches thickness). Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- H. Flexible Elastomeric:
1. Manufacturers:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacel LLC; AP Armaflex.
 2. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 3. Minimal thermal conductivity at 75° F of 0.25 (Btu.in/hr.ft². F).
- I. Mineral-Fiber Blanket Insulation:
1. Manufacturers:
 - a. Johns Manville; Microlite.
 - b. Knauf Insulation; Duct Wrap
 - c. Owens-Corning; All-Service Duct Wrap.
 2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied jackets" Article.
 3. Minimal density of 1.0 lb/ft³, installed R-value of 6.0 (at 2" thick).
- J. Mineral-Fiber Board Insulation:
1. Manufacturers:
 - a. Johns Manville; 800 Series Spin-Glas.
 - b. Knauf Insulation; Insulation Board.
 - c. Owens Corning; Fiberglas 700 Series.
 2. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 3. Minimal density of 2.25 lb/ft³, with a R-value of 8.7 (at 2" thickness).
- K. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000° Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Minimum thermal conductivity at 75° F of 0.23 (Btu.in/hr.ft². F). Comply with ASTM C

547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).
- B. Cellular-Glass, One part, acetoxy cure, silicone adhesive, with a service temperature range of minus 50 to plus 400 deg F.
 - 1. Products:
 - a. Foamglas: PC RTV 450 Sillicone Adhesive
- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products:
 - a. K-Flex: 720 LVOC or equal
- D. Phenolic: Water based adhesive with a service temp of minus 20°F to 700°F.
 - 1. Products:
 - a. Foster 97-15
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products:
 - a. Design Polymerics, DP2502 (or approved equal).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).
- B. Vapor-Barrier Mastic: Water based; suitable for outdoor use on below ambient services, or indoor vapor barrier use.
 - 1. Products:
 - a. Childers Products, Division of ITW; CP-35.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.09 perm at 55-mils film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 190 deg F.
 - 4. Solids Content: ASTM D 1644, 60 percent by volume and 73 percent by weight.
 - 5. Color: White.
 - 6. VOC: 36 g/l

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products:
 - a. Pittsburgh Corning Corporation; Pittseal 444N.
 - 2. Joint Sealant for Phenolic Products
 - a. Foster 95-50
- B. Metal Jacket:
 - 1. Products:
 - a. Foster 95-44 or equal.
 - b. Childers Products, Division of ITW; CP-76.
- C. Mineral Fiber:
 - 1. Design Polymerics DP 2502.
 - 2. Childers Products, Division of ITW; CP-35.
- D. PVC Jacket:
 - 1. Childers Products, Division of ITW; CP-35.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 2.2 oz./sq. yd. 10 x 10 strand count per square inch, minimum 4" wide band.
 1. Available Products:
 - a. Chil-glas #10.
 - b. Charles Harmon and Co. white weaveset.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, 25/50 ASTM-F 84, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products:
 - a. Johns Manville; Zeston.
 - b. Proto PVC Corporation; LoSmoke.
 2. Color: White:
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 4. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 1. Width: 4 inches.
 2. Thickness: 14.0 mils.
 3. Adhesion: 73 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 55 lbf/inch in width.
 6. Color: White
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Width: 4 inches.
 2. Thickness: 13 mils.
 3. Adhesion: 73 ounces force/inch in width.

4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. Color: Silver

2.10 SECUREMENTS

- A. Bands:
 1. Products:
 - a. Childers Products; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 1. Cupped-Head, Capacitor-Discharge-Insulated Weld Pins: Zinc-coated steel pin, fully annealed for capacitor-discharge welding, 12 Gauge shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
Contractor to field verify, integrity of pin weld on ductwork with sheet metal thickness less than 22-gauge. Integrity to be verified prior to concealment with insulation.
 - a. Products:
 - 1) GEMCO; Cupped Head Weld Pin or equal.
 2. Metal, "Peel and Press" Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products:
 - 1) GEMCO; Peel and Press or equal.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 12 Gauge diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Insulation-Retaining Washers and Cap: Self-locking cap washers formed from 12 Gauge, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

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.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application. For Stainless Steel; apply a corrosion coating to insulated surfaces with an epoxy primer and an epoxy finish 5 mils thick.
- B. Verify and coordinate insulation installation with the systems and trades installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install high-density inserts at hanger locations prior to insulating (duct and pipe); wood or block inserts are not acceptable.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Where multiple layers of insulation are required, longitudinal and end seams are to be staggered.
- H. Do not weld brackets, clips, pins or other attachment devices to piping, fittings, tanks, coils, equipment, vessel, and specialties.
- I. Keep insulation materials clean and dry before, during application, and finishing.
- J. Install insulation with tight longitudinal seams and end joints.
- K. Install insulation with least number of joints practical.
- L. Install insulation so that material is not over compressed. Install corner angles prior to insulating; to protect all insulation from damage.
- M. Seal all joints, and seams, including penetrations in insulation, at supports, and other projections with insulation of same material overlapped by 2". Secure strips with outward clinching staples along edge of overlap, (spaced 1 inch on center) and seal entire joint or seam with mastic and embedded fiberglass reinforcing mesh, minimum 4", cover mesh with finish coat of mastic.
- N. Do not insulate, conceal, or enclose pipe hangers, channel and steel supports, etc. not directly fasten to duct.
- O. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- P. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses. Do not water down products unless directed by manufacturer. Use clean potable demineralized water when required.
- Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- R. Repair all damage insulation prior to concealment as noted above.
- S. Do not insulate or conceal vibration-control devices, labels, stamps, nameplates, data plates, manholes, cleanouts, etc. require for maintenances.
- T. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarded integrity, unless otherwise indicated.
- U. Insulate pipe elbows, tees, valves, strainers, flanges, etc., using preformed fitting insulation, mitered fittings or oversized preformed pipe insulation made from same material thickness and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, voids, and irregular surfaces with insulating mastic finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. Provide a removable reusable insulation cover; design that maintains vapor barrier. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
- V. Cover segmented insulated surfaces with a layer of finishing adhesive and coat with a vapor-barrier mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- W. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Secure PVC covers to adjoining insulation facing using staples and ASJ tape. Seal PVC fitting covers with mastic.
- X. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating adhesive and finish with mastic. All connections are to be accessible.
- Y. Install removable insulation segment and covers at flanges, valves, controls, unions, equipment access doors, manholes, hand holes, and other elements that require frequent removal for service and inspection. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.4 PENETRATIONS

- A. Install insulation continuously through all walls, floors, and partitions penetrations and sleeves.
- B. Extend jacket of outdoor installation into wall and roof jacks by 2 inches. Seal jacket to roof flashing with approved flashing sealant.
- C. Insulation Installation at Fire-Rated Walls, floors and Partitions Penetrations for duct work where fire/smoke dampers are required: Terminate insulation at fire damper sleeves as required by damper manufacturer. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

3.5 GENERAL PIPE INSULATION INSTALLATION (IN ADDITION TO COMMON REQUIREMENTS)

- A. Preformed Pipe Insulation Installation on Pipe, Fittings, Valves, Flanges, Tanks, Elbows, and Appurtenances for Cellular- Glass, Mineral- Fiber, Flexible Elastomeric, and Phenolic insulations:
 1. Install insulation in a manner that secures material to system being insulated with staples, tape and mastic.
 2. When insulation with preformed pipe insulation, seal all longitudinal seams, end joints, and protrusions with manufacturers recommended tape matching jacket, vapor-barrier mastic, joint sealant, and adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 3. Secure fittings, jacket, cover, etc. with tape matching jacket and secure with outward clinched staples 1 inch on center. Apply vapor-barrier mastic over staples.

4. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.
5. Pipe hangers are not to be concealed in insulation.
6. Seal all exposed insulation ends with mastic.
7. Seal all mitered joints prior to installing covers with vapor-barrier sealant and mastic.
8. Install preformed pipe insulation to outer diameter of pipe flange.
9. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
10. Fill voids between inner circumference of valves, flange, elbows, and bolts insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
11. Install preformed sections of same material insulation when available. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Install PVC cover over fitting or mitered section.
12. Arrange insulation to permit access to valves packing, flanges, unions, etc. and valve operation for maintenance without disturbing insulation. Install insulation so that it can be removed without damage to surrounding insulation or access enclosure.

3.6 GENERAL BLANKET AND BOARD INSULATION INSTALLATION (IN ADDITION TO COMMON REQUIREMENTS)

- A. Blanket and Board Insulation Installation on Duct, Tanks, Vessels, Elbows, and Appurtenances:
 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for a minimum of 50 percent coverage of duct and plenum and 100 percent coverage of equipment, tanks, etc.; to secure insulation to surfaces. Apply adhesive to entire circumference of all surfaces; including fittings and transitions.
 2. Install cupped-head, capacitor-discharge-weld pins surfaces to secure insulation to ductwork. Install on sides and bottom of horizontal and vertical ducts having a width or height greater than 23 inches. Locate 16 inches center and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface as required by manufacturer recommendation. Use approved adhesive stick anchor pins with washers for all equipment, tanks, etc. Cut excess portion of stick anchor pins and install washer's caps. Cover exposed pins and washers caps with tape and mastic matching insulation facing.
 3. Install PVC corner angles prior to installing blanket insulation.
 4. Do not over compress insulation during installation. Cover exposed pins and washers with tape matching insulation facing and mastic.
 5. Install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 3/4-inch outward-clinching staples, 1 inch on center. Coat all seams/joints with mastic and embed with fiberglass reinforced mesh, minimum 4", cover mesh with finish coat of mastic.
 6. Repair punctures, tears, penetrations and protrusions with 6-inch-wide strips of same material used to insulate duct. Seal all seams with staples, cover with mastic and cover with embedded fiberglass reinforced mesh, cover mesh with finish coat of mastic.
 7. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside

and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

9. Insulate hangers attached to duct work. Do not insulate or enclose channel, supports, etc. not directly fasten to duct.
10. Insulation termination: Butt insulation up to termination point. Apply mastic no less than 3" overlap on insulation, and 3" on metal surface. Embed fiberglass reinforced mesh overlapping full 3" of termination point, 6" strip. Cover mesh with finish coat of mastic.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge. Secure metal jacket with stainless-steel bands 12 inches on center and at end joints.

3.8 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Inspect insulated duct, pipe, and equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two (3) location(s) for each system.
 2. All insulation applications will be considered defective work if sample inspection reveals noncompliance with requirements.
 3. Remove all defective work and install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures as needed.

3.10 INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed/exposed supply, return, relief and outdoor air.
 2. Outdoor, concealed/exposed supply, return and relief air.
- B. Piping Requiring Insulation:
 1. Indoor and outdoor hydronics.
 2. All pipe and appurtenances that are susceptible to sweating.
 3. All pipe and appurtenances carrying water or refrigerant, for space conditioning.
 4. Any piping not specifically scheduled for insulation below to be insulated with the code minimum required insulation.
- C. Items Not Insulated:
 1. Fibrous-glass ducts.
 2. Double-wall metal ducts or lined metal ducts, both with sufficient insulation thickness to comply with adopted edition of IECC and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.

4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. General building exhaust duct.

3.11 DUCT AND PLENUM INSULATION SCHEDULE

- A. Indoor, concealed, all duct insulation shall be of the following (Including dishwasher exhaust):
 1. Mineral-Fiber Blanket: 2 inches thick and 1.00-lb/cu. ft. nominal density.
- B. Indoor, exposed (including mechanical rooms and utility rooms), rectangular, all duct insulation shall be of the following:
 1. Mineral-Fiber Board: 2 inches thick and 2.25-lb/cu. ft. nominal density.
- C. Indoor, exposed round or flat oval ductwork shall be double-wall construction.
- D. Outdoor (including underfloor), all duct insulation shall be any of the following:
 1. Rectangular Duct: Cellular Glass, 3 inches thick and 7.5-lb/cu. ft. nominal density.
(minimum R-value of 8)
 2. Round/Flat Oval: Double wall construction (reference Metal Ducts Specification).

3.12 AIR DEVICE INSULATION SCHEDULE

- A. Supply-air devices (all styles/sizes): Field insulate backside of all devices that are not factory lined:
 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density. Secured to air device with FSK tape, all sides.

3.13 EQUIPMENT INSULATION SCHEDULE

- A. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- B. Expansion/compression/buffer tanks, Air-separators, filter feeders, etc. insulation shall be any of the following:
 1. Cellular Glass: 3 inches. (chilled water service)
 2. Phenolic: 2 inches. (chilled water service)
 3. Mineral Fiber Board: 3 inches. (hot water service)
- C. Steam-to-hot water heat exchanger insulation:
 1. Mineral-Fiber board: 3" thick, 3lb/cu. ft. density.
 2. Cellular Glass: 3" thick, 7.5 lb/cu. ft density.

3.14 PIPING INSULATION SCHEDULE

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.
- B. Condensate and Equipment Drains:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 1 inch thick.
- C. Chilled Water Supply and Return:
 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Pre-insulated Pipe: Reference Hydronic Piping Specification (for use underfloor, buried, and outdoors).
 - b. Cellular Glass: (for use indoors and outdoors, not accepted in underfloor or buried). Reference schedule below for thickness.
 - c. Phenolic: (for use indoors and outdoors, not accepted in underfloor or buried). Reference schedule below for thickness.
- D. Hot Water Supply and Return:
 1. All pipe sizes:
 - a. Mineral-Fiber (for use indoors) Reference table below for thickness.

- b. Pre-insulated Pipe: Reference Hydronic Piping Specification (for use underfloor and outdoors). Reference table below for thickness.
 - c. Phenolic: (for use indoors and outdoors, not accepted in underfloor or buried) Reference Schedule below for thickness.
 - d. Cellular Glass: (for use indoors and outdoors, not accepted in underfloor or buried) Reference Schedule below for thickness.
- E. Phenolic Density Schedule:
1. Indoors Concealed: 2.5 lb/ft.³ (Green)
 2. Indoors Exposed: 5 lb/ft.³ (Pink)
 3. Outdoors: 5 lb/ft.³ (Pink)
- F. Steam and Steam Condensate, 350° F and below:
1. All pipe sizes:
 - a. Mineral-Fiber, Preformed pipe, Type I: 3" thick.

Fluid	<1.5" Pipe Size					>1.5" Pipe Size				
	Cellular Glass	Phenolic	Pre-Insulated	Mineral Fiber	Flex Elastomeric	Cellular Glass	Phenolic	Pre-Insulated	Mineral Fiber	Flex Elastomeric
Chilled Water	2"	1.5"	1.5"	N/A	N/A	2"	1.5"	1.5"	N/A	N/A
Hot Water	2"	1.5"	1.5"	1.5"	N/A	2.5"	2"	2"	2"	N/A
Steam/ Condensate	N/A	N/A	N/A	3"	N/A	N/A	N/A	N/A	3"	N/A
Condensate	N/A	N/A	N/A	N/A	1"	N/A	N/A	N/A	N/A	1"
Refrigerant Suction/Hot Gas Piping	N/A	N/A	N/A	N/A	1.5"	N/A	N/A	N/A	N/A	1.5"

G. Refrigerant Suction and Hot Gas Piping:

1. All pipe sizes: Insulation shall be the following:
 - a. Flexible elastomeric: 1-½ inch thick.

3.15 FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Ducts/Piping exposed in finished indoor areas, outdoors, underfloor and mechanical rooms.
 1. Aluminum, Stucco Embossed: 0.016 inch thick.
- C. Indoor hydronic piping fitting or elbows.
 1. PVC: 0.015 inch thick.

END OF SECTION

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.
9. Ductwork Handling and Plenum Protection.
10. Ductwork Cleaning

- B. Related Sections:

1. Mechanical Specification Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.
2. Mechanical Specification Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Mechanical Specification Section "Hangers & Supports for HVAC Piping and Equipment".
4. Mechanical Specification Section "Basic Mechanical Materials and Methods".
5. Mechanical Specification Section "Special Conditions for All Mechanical Work".

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes: Variable Volume Systems
 - a. Supply Ducts: (Upstream from Air Terminal Units): 3-inch wg.
 - b. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
 - c. Return Ducts (Negative Pressure): 1-inch wg.
 - d. Outside Air Ducts (Negative Pressure): 1-inch wg.
2. Static-Pressure Classes: Constant Volume Systems
 - a. Supply Ducts: 2-inch wg.
 - b. Return Ducts (Negative Pressure): 1-inch wg.
 - c. Outside Air Ducts (Negative Pressure): 1-inch wg.
3. Static-Pressure Classes: Other Systems
 - a. Fume Hood Exhaust (negative Pressure): 3-inch wg.
 - b. General Exhaust (Negative Pressure): 1-inch wg.
 - c. Relief Air: 1-inch wg.
4. Leakage Class:
 - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at static pressure class.
 - b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at static pressure class.
 - c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at static pressure class.
 - d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at static pressure class.

- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1.4 DEFINITIONS

- A. Exposed: Open to view; not concealed by a ceiling.
1. Includes mechanical rooms.
 2. Includes outdoors.
 3. Includes crawlspace.
- B. Concealed: Covered or Concealed by a ceiling, solid inaccessible or lay-in acoustical tile.

1.5 SUBMITTALS

- A. Product Data: For each type of the following products:
1. Liners and adhesives.
 2. Sealants and gaskets.
 3. Insulation.
 4. Metal.
 5. Fasteners.
 6. Hangers.
 7. Double Wall Ductwork (Round or Flat Oval).
 8. Single Wall (Round or Flat Oval).
- B. Shop Drawings/Coordination Drawings: CADD generated, $\frac{1}{4}$ " scale. Show fabrication and installation details for metal ducts.
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Factory- and shop-fabricated ducts and fittings.
 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 4. Elevation of top of ducts.
 5. Dimensions of main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 12. Hangers and supports, including methods for duct and building attachment, and vibration isolation (where applicable).
 13. Ceiling suspension assembly members.
 14. Other systems installed in same space as ducts, including fire sprinkler piping; electrical conduits; cable trays; hydronic, domestic, and sanitary piping; and structural members.
 15. Ceiling-and-wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 16. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Field pressure test reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Seal all duct transverse joints, longitudinal seams, flanges, and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. McGill Airflow LLC.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Thickness:
 - a. 1 inch, minimum for INDOOR, exposed ducts in conditioned spaces.
 - b. 1-1/2 inches, minimum for INDOOR ducts in unconditioned spaces, including, but not limited to return-air plenums and mechanical rooms.
 - c. 2-1/2 inches, minimum for OUTDOOR ducts.
 - 3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 4. Coat insulation with antimicrobial coating.
- G. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse

(Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- H. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: **Spiral seams** complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class. **Longitudinal-seams (snap-lock) are not acceptable for any application.**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Spiral Pipe of Texas
 - e. Direct Duct

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).

- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- D. Seams: Fabricate according to the **spiral seam requirements** of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." **Longitudinal-seams (snap-lock) are not acceptable for any application, except where indicated below.**

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- F. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Lindab Inc.
 2. McGill AirFlow LLC.
 3. SEMCO Incorporated.
 4. Spiral Pipe of Texas
 5. Direct Duct

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct) of the inner duct.

- C. Outer Duct Fabrication Requirements: **Spiral seams** complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class. **Longitudinal-seams (snap-lock) are not acceptable for any application.**
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 2. Seams: Fabricate according to the **spiral seam requirements** of SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." **Longitudinal-seams (snap-lock) are not acceptable for any application, except where indicated below.**
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Thickness:
 - a. 1 inch, minimum for INDOOR, exposed ducts in conditioned spaces.
 - b. 1-1/2 inches, minimum for INDOOR ducts in unconditioned spaces, including, but not limited to return-air plenums and mechanical rooms.
 - c. 2-1/2 inches, minimum for OUTDOOR ducts.
 3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 4. Coat insulation with antimicrobial coating.
 5. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, rust, stains, discolorations, and other imperfections. All ductwork shall be a minimum of 24 gage, with a minimum thickness of 0.023 inches. Where in the SMACNA "HVAC Duct Construction Standards-Metal Flexible" it indicates that a lighter gage may be utilized, a minimum of 24 gage shall be used.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60 (Z180).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 4 mils thick on opposite surface.
 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- I. Plastic Connectors are not acceptable.

2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916. Equal to DP 2502.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer. Equal to CS-10.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildup means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL. All products are to contain low V.O.C. as defined/governed by LEED IEQ 4.1 and 4.2 (Regardless of project type).
- B. Water-Based Joint and Seam Sealant (for indoor installation):
 1. Application Method: Brush on.
 2. Solids Content: Minimum 68 percent.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. VOC: less than 30 g/l (less water).
 6. Maximum Static-Pressure Class: 15-inch wg, positive and negative.
 7. Service: Indoor.
 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 9. DP 1020 or approved equal.
- C. Water-Based Joint and Seam Sealant (for outdoor installation):
 1. Application Method: Tube application or dry tooling.
 2. Service Temp Range (degrees F): -40 to 180.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. Service: Indoor.
 6. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 7. Sonolastic NP-1 or approved equal.
- D. Flanged Joint Sealant: Comply with ASTM E-84.
 1. General: Butyl gasket tape.

2. Type: Butyl Rubber.
3. Service Temperature: Minus 40°F to 245°F
4. Pressure Class: All
5. DP 1040

2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. All ductwork sizes indicated on drawings are internal, free area dimensions. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- H. Coordinate layout with suspended ceiling, fire-and smoke-control dampers, lighting layouts, and similar finished work.
- I. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws. Sealant of seems/joints to include (but not limited to): all joints (including gasketed joints) metal seams, taps, any connections, etc.
- J. Paint interiors of metal ducts that do not have duct liner, for 24 inches (600 mm) upstream of return air registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.
- K. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- L. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness. Compression of insulation by other trades (pipe, conduit, etc) is not acceptable.
- M. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- N. Where ducts pass through non-fire-rated interior partitions and exterior walls, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- O. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Mechanical Specification Section "Duct Accessories" for fire and smoke dampers.
- P. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- Q. Horizontal ductwork in mechanical rooms must be installed a minimum of 8'-0" AFF.
- R. All duct floor penetrations must have a water-tight, continuous concrete curb surrounding them. Minimum curb size shall be 3-1/2" tall X 3-1/2" wide.

3.2 DUCTWORK HANDLING AND PLENUM PROTECTION

- A. All ductwork shall be delivered to site and stored with all openings protected from the elements. Protection to include 2.5 mil thick polyethylene plastic film secured with tape or integral elastic band.
- B. Each segment/section of ductwork installed is to be appropriately protected from elements.
- C. Any ductwork damaged during delivery, installation, or at any time during construction will be removed from job and replaced.
- D. Ductwork found onsite (installed or stored) without approved protection will be removed from job and replaced.
- E. Ductwork installed exposed to the elements to be sealed (joints and seems) immediately after installation. Any ductwork not sealed is susceptible to rejection and removed from job.
- F. Under no circumstances shall insulation be applied to ductwork prior to the building being fully dried in (i.e.: building sealed, windows and roof installed, etc). Any ductwork being insulated prior to building dry-in is susceptible to rejections and removed from job.
- G. If ductwork is found onsite not protected or the newly installed ductwork is deemed as dirty, engineer can elect for the contractor to clean all duct at no cost to the owner per NADCA 1992.

3.3 SEAM AND JOINT SEALINGS

- A. Seal all duct transverse joints, longitudinal seams, flanges and duct wall penetrations (SMACNA Seal Class-A regardless of static pressure construction class).

3.4 HANGERS AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4 "Hangers and Supports," unless otherwise indicated.
 1. Support rectangular ducts greater than 36 inches with width with trapeze threaded rod and angle or channel supports. Straps not acceptable.
 2. Rectangular Duct Hangers Exposed to View: Threaded rod and channel supports (do not use steel angles).
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," Table4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and

- supports within 24 inches of each elbow and within 48 inches of each branch intersection. Elbows 36" and larger to be individually supported.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16' feet. Support vertical ducts in a manner that introduces minimal weight onto the roof curb flange.
 - E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Do not attach hangers to metal deck roof assemblies with built-up insulation only (no concrete). Attach only to structural steel members.

3.5 CONNECTIONS

- A. Make all connections to all fan-bearing equipment with flexible connectors complying with Specification Section "Duct Accessories".
- B. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for branch, outlet and inlet, and terminal unit connections. Reference detail for specific additional items required.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Section.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Leakage Class defined in previous sections of specification. (Amount of ductwork to be tested to be determined by Engineer or Field Inspector).
 - 2. Test the following systems:
 - a. Medium Pressure Ductwork (3-Inch wg), up to Air Terminal (branch taps included): Test representative duct sections totaling no less than 100 percent of total installed duct area.
 - b. Low Pressure Supply Ducts: Test representative duct totaling no less than 20 percent of total installed duct area.
 - c. Return Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
 - d. Exhaust Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
 - e. Outdoor Air Ducts: Test representative duct sections totaling no less than 20 percent of total installed duct area.
 - f. Grease Laden/Dishwasher Exhaust: Test representative duct sections per IMC "Light Test."
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before insulation application.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Contractor to disassemble, reassemble and seal segments of systems to accommodate leakage testing and for compliance with test requirements / leakage rates.
- E. All testing equipment to be calibrated (by manufacturer) within 3 years of onsite duct pressure testing. Documentation to be provided for verification of certification to Engineer through submittal process.

F. Test Coupons: Cut out three (3) 4x4" test coupons in random locations selected by the design engineer for verification of gage thickness. Coupons shall be taken at the time of pressure testing.

G. Prepare test and inspection reports.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as follows:

1. Acid-Resistant (Fume-Handling) Ducts:

- a. Type 304, stainless-steel sheet – welded.
- b. Exposed to View: No. 4 finish.
- c. Concealed: No. 2D finish.

2. Moist Environment Ducts: Aluminum.

3. Spaces with pools, spas, hot tubs or water features: Aluminum.

4. Kitchen Exhaust – Reference applicable specification.

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts: Galvanized steel.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Liner:

1. Transfer Ducts: Fibrous glass, Type I 1 inch thick.

D. Double-Wall Duct Schedule:

1. All exposed Round/Flat Oval Ductwork.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-2, "Rectangular Elbows".

a. Velocity 1000 fpm or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support Elbows."

c. Velocity 1500 fpm (7.6 m/s) or Higher:

- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-3, "Round Duct Elbows".

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

- 3) Velocity 1500 fpm or higher: 1.5 radius-to-diameter and five segments for 90-degree elbow.
 - b. Round Elbows, 12 inches and smaller diameter: Stamped or pleated.
 - c. Round Elbows, 14 inches and larger in diameter: Welded.

F. Branch Configuration

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Side takeoff fitting.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or higher: 45-degree lateral.

3.9 CLEANING NEW SYSTEMS

- A. If ductwork is found onsite not protected or the newly installed ductwork is deemed as dirty, engineer can elect for the contractor to clean all duct at no cost to the owner per NADCA 1992.
- B. System Cleaning: (If required)
 1. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
 2. Provide service openings (approved duct access doors), as required, for physical and mechanical entry during cleaning and for inspection. All duct access doors to be installed prior to any duct pressure tests.
 - a. Removed and reinstall ceiling sections to gain access during the cleaning process.
 3. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust downwind and minimum of 20 feet away from air intakes and other points of entry into building.
 4. Clean the following metal duct systems by removing surface contaminants and deposits:
 - a. Air outlets and inlets (registers, grilles and diffusers).
 - b. Supply, return and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers and drive assemblies.
 - c. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - d. Coils and related components.
 - e. Return-air ducts, dampers and actuators except in ceiling plenums and mechanical equipment rooms.
 - f. Supply-air ducts, dampers, actuators and turning vanes.
 5. Mechanical Cleaning Methodology:
 - a. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - b. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - c. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner or duct accessories.
 - d. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.

- e. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- 6. Cleanliness Verification:
 - a. Visually inspect metal ducts for contaminants.
 - b. Where contaminants are discovered, re-clean and re-inspect ducts.

END OF SECTION

SECTION 23 3300 **DUCT ACCESSORIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire dampers
4. Fire and smoke dampers.
5. Turning vanes.
6. Duct-mounted access doors and panels.
7. Flexible ducts.
8. Flexible connectors.
9. Side takeoff fittings.
10. Duct accessory hardware.
11. Motorized control dampers.

- B. Related Sections include the following:

1. Specification Section "Access Doors and Frames" for wall- and ceiling-mounted access doors and panels.
2. Specification Section "Louvers and Vents" for intake and relief louvers and vents connected to ducts and installed in exterior walls.
3. Specification Section "Air Terminal Units" for constant-volume and variable-air-volume control boxes and reheat boxes.
4. Specification Section "Intake and Relief Ventilators."
5. Specification Section "Instrumentation and Controls for HVAC" for electric damper actuators.

1.3 SUBMITTALS

- A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire dampers.
4. Fire and smoke dampers.
5. Duct-mounted access doors and panels.
6. Flexible ducts.
7. Motorized control dampers.
8. Side takeoff fittings

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.063-inch thick extruded aluminum, with mounting flange.
- C. Blades: 0.050-inch thick aluminum sheet.
- D. Blade Seals: Felt.
- E. Blade Axles: Nonferrous.
- F. Tie Bars and Brackets: Aluminum.
- 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.
 - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Standard Volume Dampers: Multiple- or single-blade, opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Roll-Formed Steel Blades: 0.064-inch thick, galvanized, sheet steel.
 - 2. Blade Axles: Galvanized steel.
 - 3. Tie Bars and Brackets: Galvanized steel.
 - 4. 1-1/2-inch insulation buildup with locking quadrant.
- C. Low-Leakage Volume Dampers: Multiple- or single-blade, opposed-blade design, low-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 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 thick, galvanized, sheet steel.
 - 3. Blade Seals: Felt.
 - 4. Blade Axles: Galvanized steel.
 - 5. Tie Bars and Brackets: Galvanized steel.
 - 6. 1-1/2-inch insulation buildup with locking quadrant.
- D. Jackshaft: 1-inch 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.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- F. Remotely Operated Damper Accessories:

1. Galvanized steel rotary cable with termination for adjustment either at the diffuser face or at a wall- or ceiling-recessed box/cup as shown on drawings. Secure other cable end to damper worm gear assembly. Cable must be one-piece with no linkages along the length. Provide mounting clips to support cables at all changes in direction and at 3-foot intervals.

2.4 FIRE DAMPERS

- A. General: Labeled to UL 555 (sixth edition). Ruskin Model D1BD2-B (or design engineer approved equivalent). Dampers shall be marked with a UL-Classified fire protection rating and marked "For Use in Dynamic Systems".
- B. Fire Rating: One and one-half and/or three hours as indicated.
- C. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Provide factory-mounted sleeve and retaining angles.
 1. Minimum Thickness (Sleeve shall not extend more than 6" past wall or floor without factory installed access door): 16 gauge and length to suit application.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- H. Fusible Link: Replaceable, 165 deg F rated as indicated.

2.5 COMBINATION FIRE / SMOKE DAMPERS (SFD)

- A. General: Labeled to UL 555/UL 555S (sixth and fourth edition respectively) Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555S. Provide Class II leakage rating. Dampers shall be marked with a UL-classified fire rating. Ruskin FSD-60 or approved equivalent. The SFD shall be listed to operate from the fire alarm control panel (FACP). Each SFD shall have an associated smoke detector that shall be addressable from the FACP. The smoke detector shall be provided by the Fire Alarm Contractor and installed by the Electrical Contractor. Coordinate damper installation with these trades.
- B. Electric Fusible Link (EFL): 165 or 212 deg F rated as applicable.
- C. Frame and Blades: 16 gauge, galvanized, sheet steel. Damper blades shall be airfoil-shaped, single-piece construction, with blade seals mechanically locked into blade edge (adhesive clip-on seals are not acceptable). Ruskin FSD-60 or equivalent. Damper blades shall be minimum 14 gauge. SFD's installed off vertical chases shall have vertical airfoil blades (Ruskin FSD 60-V or equivalent).
- D. Mounting Sleeve: Factory-installed, 16 gauge, galvanized, sheet steel; length to suit wall or floor application. Sleeve shall not extend more than 6" past wall or floor without factory installed access door. SFD shall be capable of mounting on either side of wall and working with airflow in either direction. Provide manufacturer-recommended duct-to-sleeve joints.
- E. Electric controlled closure is not less than 7 seconds or more than 10 seconds to prevent HVAC and duct damage. Damper shall have local reset button and shall have automatic reset after test, smoke detection or power failure conditions. Damper shall close upon loss of power or AHU shut down. Actuator shall be 120V.
- F. Provide with stainless steel jam seals and bearings. (Bronze bearings are not acceptable)
- G. Furnish and install dampers according to manufacturer's instructions and in compliance with the latest edition of the SMACNA Duct Manual and NFPA Standards (90, 92A, and 92B).

2.6 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.

2.7 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. Manufacturers:
 1. Greenheck
 2. Flexmaster
 3. Elgens
 4. No exceptions
- B. Ratings
 1. Differential Pressure
 - a. Access doors shall have a maximum differential pressure rating of 4.5 in.wg.
- C. Construction
 1. Frame
 - a. Access door shall be constructed of 27 ga. Galvanized steel on sizes up to 12 in. x 12 in. On sizes 14 in. x 14 in. and larger shall be constructed of 22 ga. Galvanized steel.
 2. Door Panel: Door panel is constructed of 24 ga. Galvanized steel on both sides of the insulation.
 3. Insulation: Insulation is 1 in. fiberglass.
 4. Gasket: Gasket is ½ in. wide dual gasket (compressible synthetic type). Gasket is to be used door to frame and frame to duct.
 5. Hinge: Continuous piano style.
 6. Latches: Latches is plated steel with galvanized steel strikes.
 7. Finish: Mill finish is standard.

2.8 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 wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- C. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.
- D. 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.
 2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

2.9 INSULATED FLEXIBLE DUCT, LOW PRESSURE

- A. Manufacturers:
 1. Flexmaster type 1M UL181 Class I Air Duct.
 2. Thermaflex MK-E.
 3. No exceptions.
- B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel.

- C. The internal working pressure rating shall be at least 6" w.g. positive and 4" w.g. negative, with a bursting pressure of at least 2-1/2 times the working pressure.
- D. The duct shall be rated for a velocity of at least 4000 feet per minute.
- E. The duct must be suitable for continuous operation at a temperature range of -20 deg F to +250 deg F.
- F. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1*, Section 3.0, Sound Properties, shall be as follows:
 - 1. The insertion loss (dB) of a 6-foot length of straight duct when tested in accordance with ASTM E 477, at a velocity of 500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	11	33	36	37	19	14
8" diameter	13	35	34	37	29	17
12" diameter	10	26	26	32	24	11
- G. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 6 at a mean temperature of 75 deg F.
- H. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim (FSK) having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, Procedure A.

2.10 SIDE TAKEOFF FITTINGS

- A. Provide Flexmaster Model STOD or SBMD takeoff for sheet metal for all taps connecting to flex duct, except for air devices with OBD's and flow bar. For devices with OBD, use Flexmaster Model STO- or SBM no exceptions.
- B. The side takeoff fittings shall maintain a ratio of 1:1 of inlet to outlet on all units over 7-inch diameter to allow proper sizing of the duct system.
- C. Model STOD side takeoff shall have a 1-inch offset rear edge for enhanced pressure drop characteristics and 1-1/2-inch insulation buildup with locking hand quadrant.
- D. Fittings shall have a 1-inch-wide prepunched mounting flange with corner clips and adhesive gasket for minimal leakage and ease of installation.
- E. The fittings shall be constructed of a two-piece 26-gauge G-90 galvanized steel body and collar.
- F. The overall length of the fitting shall be 13 inches with or without damper to reduce turbulence in the airstream.
- G. The round outlet shall be provided with a rolled stiffener bead for strength and ease of installation and sealing of spiral and flexible ductwork joints.

2.11 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, 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 to suit duct size.

- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 MOTORIZED CONTROL DAMPERS

- A. Manufacturers:
1. Greenheck.
 2. Nailor Industries Inc.
 3. Ruskin Company.
 4. Pottorff.
- B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.
1. Secure blades to ½-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Provide parallel or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in.xlbf (5.6 Nxm); when tested according to AMCA 500D.

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. When installing volume dampers in lined duct, avoid damage to and erosion of duct liner.
- C. Install manual volume dampers at all main branch lines for ease of balancing.
- D. Insulated flexible ductwork, maximum allowable length: no more than 5ft.
- E. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- F. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
 1. Install fusible links in fire dampers.
- G. Install mounting angles, minimum of 1 ½ "x 1 ½ "x 20 gauge steel on both sides of SFD or FD.
- H. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, smoke-fire dampers, turning vanes, and equipment.
- I. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting and maintaining accessories and terminal units.
 1. Install access panels on side of duct where adequate clearance is available.
 2. Label access doors according to Specification Section "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Specification Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3423
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
1. Ceiling-mounting ventilators.
 2. Centrifugal roof ventilators
 3. Desratification fans
 4. In-line centrifugal fans.
 5. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
1. Fan performance data including capacities, static pressure, sound power characteristics, motor requirements and electrical characteristics.
 2. Fan arrangement, including wheel configuration inlet and discharge configurations and required accessories.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties and accessories for each type of product indicated 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 thickness and finishes, including color charts.
 5. Dampers, including housings, linkages and operators.
 6. Roof curbs.
 7. Fan speed controllers.
- 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.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and base weights.
- C. Coordination Drawings: Show roof penetration requirements and reflected ceiling plans drawn to scale and coordinating roof penetrations and units mounted above ceiling. Show the following:
1. Roof framing and support members relative to duct penetrations.
 2. Ceiling suspension assembly members.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

- D. Maintenance Data: For power ventilators to include in maintenance manuals specified in Division 1 Section "Operation and Maintenance Data".

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. AMAC 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.
- D. UL Standard: Power ventilators shall comply with UL 705.
- E. Listing and labeling: Provide electrically operated fixtures specified in this section that are listed and labeled.
 - 1. The terms "Listed" and "Labeled". As defined in the Nations Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- F. UL Standard: Provide Power Ventilators that comply with UL 762, grease laden air at 300 deg. F where applicable (kitchen exhaust).
- G. Warranty: The manufacturer's standard warranty shall be for a period of 12 months from the date of Substantial Completion. Warranty is limited to manufacturer defects only. The warranty shall include parts and labor during this period.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, are required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Specification Section "Cast-In-Place Concrete".
- C. Coordinate installation of roof curbs, equipment supports and roof penetrations. These items are specified in Specification Section "Roof Accessories".

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field Measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated and fans have been commissioned.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Centrifugal Roof Ventilators:
 - a. Cook, Loren Company
 - b. Envirofan
 - c. Greenheck Fan Corp.
 - d. Leading Edge

2.2 CEILING-MOUNTING VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- B. Housing: Steel, lined with acoustical insulation
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor and fan wheel shall be removable for service.
- D. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Filter: Washable aluminum to fit between fan and grille.
 3. Isolation: Rubber-in-shear vibration isolators.
 4. Manufacturer's standard roof jack or wall cap and transition fittings.
- G. Capacities and Characteristics: Refer to drawing schedules.

2.3 CENTRIFUGAL ROOF VENTILATORS – DOWNBLAST

- A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, two-piece, aluminum base with venture inlet cone.
- C. Fan Wheels: aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 1. Fan Shaft: turned, ground, and polished stainless steel; keyed to wheel hub.
 2. Shaft Bearings: Heavy-duty re-greasable ball type in a pillow block cast iron housing, selected for a minimum L50 life in excess of 200,000 hours.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
 5. Belts: Oil and heat resistant, nonstatic.
- E. Accessories: The following items are required as indicated:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent (required on direct drive fans only).
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailing. Size as required to suit roof opening and fan base. Built in cant and mounting flange.
 1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 18 inches
 3. Pitch Mounting: Manufacture curb for roof slope, if necessary.

4. Metal Liner: Galvanized steel.

2.4 CENTRIFUGAL ROOF VENTILATORS – UPBLAST

- A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories. Grease laden fans to comply with UL 762 Grease Laden Air.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, two-piece, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 1. Fan Shaft: Turned, ground and polished stainless steel; keyed to wheel hub.
 2. Shaft Bearings: heavy-duty re-greasable ball type in a pillow block cast iron housing, selected for a minimum L50 life in excess of 200,000 hours.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- E. Accessories: The following items are required as indicated:
 1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through in internal aluminum conduit.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailing. Size as required to suit roof opening and fan base.
 1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 18 inches
 3. Pitch Mounting: Manufacture curb for roof slope, if necessary.
 4. Metal Liner: Galvanized steel.
 5. Vented Curb Extension, with hinged curb cap.

2.5 DESTRATIFICATION FANS

- A. Ceiling Fans 60" diameter 3 blade fan, dynamically balanced with permanently lubricated ball bearing motor, U.L. listed (UL 507), with all necessary hooks and supports for a complete installation. Provide solid state speed controllers and secondary support cable.
- B. Wall Mount Circulators: 24" 3-blade oscillating fan. Wall bracket, 2-speed motor, powder coated for guards, heavy duty pull chain, 45°-90° sweep. Safety cable mounting kit.

2.6 IN-LINE CENTRIFUGAL FANS (TUBULAR)

- A. Description: In-line, direct or belt-driven (as scheduled on the drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets and accessories.
- B. Housing: Spilt, spun aluminum with aluminum straightening vanes, inlet and outlet flanges and support bracket adaptable to floor, side wall or ceiling mounting.
- C. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, air foil blades welded to aluminum hub.
- F. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Companion Flanges: For inlet and outlet duct connections.

3. Fan Guards: 1/2 by 1 inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

G. Capacities and Characteristics: Refer to drawing schedules.

2.7 IN-LINE CENTRIFUGAL FANS (SQUARE)

- A. Description: In-line, direct driven (as scheduled on the drawings) centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets and accessories.
- B. Housing: Insulated and galvanized with inlet and outlet flanges and support bracket adaptable to floor, side wall or ceiling mounting.
- C. Direct-Driven Units: ECM Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- D. Fan Wheels: Aluminum, backward inclined air foil blades welded to aluminum hub.
- E. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Companion Flanges: For inlet and outlet duct connections.
 3. Housing Insulation.
 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
- F. Capacities and Characteristics: Refer to drawing schedules.

2.8 PROPELLER FANS

- A. Description: Direct-or belt-driven (as scheduled on the drawings) propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly and accessories.
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factor set pitch angle of blades.
- E. Belt-Drive Drive Assembly: Resiliently mounted to housing, 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.
 1. Service Factor Based on Fan Motor Size: 1.4.
 2. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.
 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L₁₀ of 100,000 hours.
 4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
 5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 7. Belt Guards: Fabricate of steel motors mounted on outside of fan cabinet.
- F. Accessories:
 1. Gravity Shutters: Aluminum blades in aluminum fame; interlocked blades with nylon bearings.
 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
- G. Capacities and Characteristics: Refer to drawing schedules.

2.9 MOTORS

- A. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- B. Enclosure Type: The following features are required as indicated.
 1. Open drip proof motors where satisfactorily housed or remotely located during operation.
 2. Guarded drip proof where exposed to contact by employees or building occupants.
- C. All motors shall be pre-wired to the disconnect at the factory.

2.10 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 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 power ventilators level and plumb.
- B. Support inline fans with galvanized all thread and spring isolators with a static deflection of 1 inch.
- C. Support suspended units from structure using galvanized threaded steel rods and spring hangers.
- D. Secure roof-mounting fans to roof curbs with stainless steel hardware. Anchor fan to curb with a minimum of two (2) fasteners per side. Refer to Specification Section "Roof Accessories" for installation of roof curbs.
- E. Ceiling Units: Suspect units from structure; use steel wire or metal straps.
- F. Install units with clearances for service and maintenance.
- G. Label units according to requirements specified in Specification Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Mechanical Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors for all fans; no exceptions. Flexible connectors are specified in Specification Section "Duct Accessories."
- B. Install duct adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Specification Section "Grounding and Bonding."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Verify that shipping, blocking and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters and disconnect switches.
 3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork system are in fully open positions.
 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- B. Starting Procedures:
1. Energize motor and adjust fan to indicated rpm.
 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Specification 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. Refer to Specification Section "Testing, Adjusting and Balancing" for testing, adjusting and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. 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 burns, dirt and construction debris and repair damaged finished.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
 1. Train owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting servicing, and maintaining equipment and schedules.
 2. Review data in maintenance manuals. Refer to Specification Section "Closeout Procedures."
 3. Review data in maintenance manuals. Refer to Specification Section "Operation and Maintenance Data."

4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.7 COMMISSIONING

- A. Final Checks before Startup: Perform the following operations and checks before startup:
 1. Verify that shipping, blocking and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters and disconnects.
 3. Perform cleaning and adjusting specified in this Section.
 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. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.
 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
 7. Disable automatic temperature-control operators.
- B. Starting Procedures for fans are as follows:
 1. Energize motor; verify proper operation of motor, drive system and fan wheel. Adjust fan to be indicated RPM.
 2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Specification Section "Testing, Adjusting and Balancing," for procedures for air-handling-system testing, adjusting and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

END OF SECTION

SECTION 23 3713
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 1. Specification Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
 2. Specification Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 3. Schedule of diffusers, registers, and grilles indicating drawing designation, 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.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Krueger
 2. Metalaire
 3. Price
 4. Titus
- B. Performance characteristics, specific models, material, features, dimensions and finishes of diffusers, registers, and grilles are scheduled on Drawings.

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. Coordinate with architectural Reflected Ceiling Plans. Locate devices where indicated, as much as practical. 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 8126
SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes split system air conditioning and heat pump units consisting of separate evaporator fan and compressor condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Specification Compliance Review:
 - 1. Manufacturers and bidders must provide the consulting engineer with a Compliance Review of the Specifications and Addenda's. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications and schedule with the following information; "C", "D", or "E" marked in the margin of the original Specifications and any subsequent Addenda's. If the manufacturer or bidder does not provide the Compliance Review to the engineer for review, with the submittal, the submittal will be subject to rejection as non-compliant.
 - a. "C" Comply with no exceptions.
 - b. "D" Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - c. "E" Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives. Non-compliance with the specifications is grounds for rejection as unacceptable. A bid from any alternative or listed equipment manufacturer with any number of exceptions will be reason for rejection for non-compliance without further review.
 - d. Unless a deviation or exception is specifically noted in the Compliance Review, the manufacturer shall provide full compliance with entire specification. Deviations or exceptions taken in letters or cover letters in a bid document, subsidiary documents, by omission or by contradiction do not release the manufacturer or bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review and approved by the consulting engineer.
 - e. Equipment manufacturers or bidders that do not meet the specifications thru the above process will be subject to rejection without further review.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Field quality-control test reports.
- F. Operational and Maintenance Data: For split-system air-conditioning units to include in emergency operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Specification Section "Product Requirements."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio (EER): Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Specification Section "Special Conditions for All Mechanical Work."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Specification Section "Special Conditions for All Mechanical Work."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carrier Air Conditioning; Div. of Carrier Corporation
 2. Lennox Industries, Inc.
 3. Trane Company (The); Unitary Products Group.
 4. York International Corp.
 5. JCI

2.2 CONCEALED EVAPORATOR-FAN COMPONENTS

- A. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 1. Insulation: Faced, glass-fiber duct liner.
 2. Drain Pans: Galvanized steel, with connection for drain; insulated.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contractors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
- D. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- E. Fan Motors:
 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- F. Disposable Filters: 1 inch (25 mm) thick, in fiberboard frames.
- G. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal expansion valve.

- C. Electric Coil: Helical, nickel chrome, resistance wire heating elements with refractory ceramic support bushings; automatic reset thermal cutout; built in magnetic contactors; manual reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
- D. Fan: Direct drive, centrifugal fan.
- E. Fan Motors:
 - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- F. Filters: Permanent, cleanable.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Scroll
 - 2. Manual reset high pressure switch and automatic reset low pressure switch.
 - 3. Refrigerant Charge: R-410.
 - 4. 1 Compressor per unit
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub-cooler. Coil shall be provided with a metal hail guard of either louvered construction or $\frac{1}{2}$ " x $\frac{1}{2}$ " wire mesh.
- D. Heat Pump Components: Reversing valve and low temperature air cut-off thermostat.
- E. Fan: Aluminum propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal overload protection.
- G. Coordinate with drawing schedule for additional requirements.

2.5 ACCESSORIES

- A. Unit shall have local control unless specified to be part of central control system.
- B. Low-Voltage Control Wiring: Provide plenum-rated cabling (six-conductor) per manufacturer.
- C. Thermostat: Low-voltage, programmable, with the following functions and features:
 - 1. Auto changeover (heat/cool).
 - 2. Seven-day programmable with three (3) different occupied settings per day.
 - 3. Large backlit liquid crystal display indicating temperature, setpoint temperature, time setting, operating mode, and cool/heat mode.
 - 4. Three (3) security levels with keypad lockout.
 - 5. Non-volatile memory.
 - 6. Four-hour override/setback.
 - 7. Seven-day holiday setback.
 - 8. Zone averaging
- D. Automatic reset timer to prevent rapid cycling of compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator fan components using manufacturer's standard mounting devices securely fastened to building structure.

- C. Install ground mounting, compressor condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Specification Section "Special Conditions for All Mechanical Work." Coordinate anchor installation with concrete base.
- D. Install compressor condenser components on equipment supports specified in Specification Section "Special Conditions for All Mechanical Work." Anchor units to supports with removable, cadmium plated fasteners.
- E. Install condensing unit on Korfund or equal pads and secure to housekeeping pad.
- F. Charge unit with manufacturer required refrigerant and amount.
- G. Support refrigerant piping from structure with hangers and saddles.
- H. Insulate refrigerant lines with Armaflex. Provide aluminized jacket for exterior insulation.
- I. Install t-stat in room on wall not in airflow stream. Connect t-stat to compressor/evaporator.
- J. Provide condensate overflow switch to de-energize unit.
- K. Provide and install plenum rated control cabling between condensing unit and evaporator.

3.2 CONNECTIONS

- A. Connect condensate line to unit. Route condensate to floor drain. Support piping from structure with pipe hangers. Insulate condensate line with Armaflex.
- B. Connect unit to controls system. Controls shall alarm with unit failure.
- C. Piping installation requirements are specified in other **Mechanical and Plumbing** Sections.
- D. Install piping adjacent to unit to allow service and maintenance.
- E. Duct Connections: Duct installation requirements are specified in Specification Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split system air conditioning units with flexible duct connectors. Flexible duct connectors are specified in Specification Section "Duct Accessories."
- F. Ground equipment according to Specification Section "Grounding and Bonding."
- G. Electrical Connections: Comply with requirements in electrical specification sections for power wiring, switches, and motor controls. Install control wiring in conduit per electrical specification sections. All cabling shall be plenum rated. Disconnects shall be provided for the evaporator and condensing unit. Provide conduit and conductors from condensing unit to evaporator in conduit. Minimum #10 wire.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 23 8219
FAN-COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension components.
 - 2. Structural members to which fan-coil units will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 6. Perimeter moldings for exposed or partially exposed cabinets.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- F. Warranty: Special warranty specified in this Section.

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.

1.6 COORDINATION

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Compressor failure.
 - b. Condenser coil leak.
 - 2. Warranty Period (Compressor Only): Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan-Coil-Unit Filters: Furnish one (1) spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In the Fan-Coil-Unit Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each fan-coil unit is based on the product named on the drawing schedule. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 FAN-COIL UNITS

- A. Manufacturers: Subject to compliance with requirements; provide products by one of the following:
 - 1. Carrier Corporation.
 - 2. Lennox Industries, Inc.
 - 3. McQuay International.
 - 4. Trane.
 - 5. YORK International Corporation.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: 1-inch (25-mm) thick foil-faced glass fiber insulation, complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
- D. Main and Auxiliary Drain Pans: Plastic, stainless steel, or insulated galvanized steel with plastic liner formed to slope from all directions to the drain connection as required by ASHRAE 62.
- E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.
- F. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color.
- G. Outdoor-Air Damper: Galvanized-steel blades with edge and end seals and nylon bearings; with electronic, modulating actuators.
- H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. 2-inch (50 mm) permanent frame with replaceable media.
 - 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.

3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.
- J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- K. Fan and Motor Board: Removable.
 1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Specification Section "Motors."
 3. Wiring Termination: Connect motor to chassis wiring with plug connection.
- L. Factory, Hydronic Piping Package: ASTM B 88, Type L (ASTM B 88M, Type B) copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
 1. [Two] [Three]-way, [two-position] [modulating] control valve for chilled-water coil.
 2. [Two] [Three]-way, [two-position] [modulating] control valve for heating coil.
 3. [Two] [Three]-way [two-position] [modulating] control valve for hot-water reheat coil.
 4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
 5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig (2070-kPa) working pressure at 250 deg F (121 deg C), with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
 6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) hose-end, full-port, ball-type blowdown valve in drain connection.
 7. Wrought-Copper Unions: ASME B16.22.
- M. Control devices and operational sequences are specified in Specification Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."
- N. Electrical Connection: Factory wire motors and controls for a single-point electrical connection.

2.3 DUCTED FAN-COIL UNITS

- A. Manufacturers: Subject to compliance with requirements; provide products by one of the following:
 1. Carrier Corporation.
 2. Lennox Industries, Inc.
 3. McQuay International.
 4. Trane.
 5. YORK International Corporation.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: 1-inch (25-mm) thick foil-faced glass fiber insulation, complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
- D. Main and Auxiliary Drain Pans: Plastic, stainless steel, or insulated galvanized steel with plastic liner formed to slope from all directions to the drain connection as required by ASHRAE 62.
- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
 1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
 2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
 3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
 4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.
- G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. 2-inch (50 mm) permanent frame with replaceable media.
 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
 3. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
- I. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig (3105 kPa) for a minimum 300-psig (2070-kPa) working pressure. Include thermal expansion valve.
- J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- K. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
- L. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 1. Motors: Comply with requirements in Specification Section "Motors."
- M. Factory, Hydronic Piping Package: copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
 1. [Two] [Three]-way, [two-position] [modulating] control valve for chilled-water coil.
 2. [Two] [Three]-way, [two-position] [modulating] control valve for heating coil.
 3. [Two] [Three]-way, [two-position] [modulating] control valve for reheat coil.
 4. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.
 5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig (2070-kPa) working pressure at 250 deg F (121 deg C); with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow

- with plus or minus 10 percent over differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) hose-end, full-port, ball-type blowdown valve in drain connection.
 7. Wrought-Copper Unions: ASME B16.22.
- N. Remote Condensing Units: Factory assembled and tested, consisting of compressors, condenser coils, fans, motors, refrigerant receiver, and operating controls. Construct, test, and rate condensing units according to ARI 210/240 and ASHRAE 15.
1. Casing: Steel with baked-enamel finish, removable panels for access to controls, weep holes for water drainage, and mounting holes in base.
 2. Compressor: Hermetic, scroll type; internally isolated for vibration with factory-installed safety devices as follows:
 - a. Antirecycle timer.
 - b. High-pressure cutout.
 - c. Low-pressure cutout or loss-of-charge switch.
 - d. Internal thermal-overload protection.
 - e. Current and voltage sensitive safety devices.
 3. Compressor Motor: Start capacitor, relay, and contactor. Comply with requirements in Specification Section "Motors."
 4. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
 5. Charge: R-407C or R-410A refrigerant.
 6. Low ambient controls to permit operation down to 20 deg F (7 deg C).
 7. Crankcase heater.
 8. Charging and service fittings on exterior of casing.
 9. Filter dryer.
 10. Air-to-Air Heat Pump: Pilot-operated, sliding-type reversing valve with replaceable magnetic coil, and controls for air-to-air heat pump operation with supplemental heat operation.
 11. Hot-gas-bypass, constant-pressure expansion valve and controls to maintain continuous refrigeration system operation at 10 percent of full load.
 12. Condenser: Copper-tube, aluminum-fin coil, with liquid subcooler.
 13. Condenser Fan: Direct-drive, aluminum propeller fan.
 - a. Motor: Comply with requirements in Specification Section "Motors."
- O. Control devices and operational sequence are specified in Specification Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."
- P. Electrical Connection: Factory wire motors and controls for a single-point electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.

- C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Specification Section "Mechanical Vibration and Seismic Controls."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices **48 inches (1220 mm)** above finished floor.
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Mechanical Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 1. Install piping adjacent to machine to allow service and maintenance.
 2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose. All connections shall be hard-piped; hose connections are not permitted.
 3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
 - b. Provide and install a condensate detection system that shuts down the unit fan upon an overflow condition, as required by the local code authority.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Specification Section "Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Specification Section "Grounding and Bonding."
- D. Connect wiring according to Specification Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 23 8560
INTAKE AND RELIEF VENTILATORS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of roof-mounting intake and relief ventilators:
 1. Roof hoods.
 2. Goosenecks
- B. Related Sections include the following:
 1. Specification Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
 2. Specification Section "Power Ventilators" for roof-mounting exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- C. Product Options: Drawings indicate size, profiles and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Section "Product 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.
- D. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.2, "Structural Welding Code-Aluminum."
 2. AWS D1.3, "Structural Welding Code-Sheet Steel."

1.6 COORDINATION

- A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.4 ROOF HOODS

- A. Manufacturers:
 1. Greenheck.
 2. Loren Cook Company.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
- C. Materials: Aluminum sheet, minimum 0.063-inch- (1.6-mm-) thick base and 0.050-inch- (1.27-mm-) thick hood; suitably reinforced.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded comers: 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailing. Size as required to fit roof opening and ventilator base.
 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 2. Overall Height: 12 inches (300 mm).
- E. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.
- F. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 GOOSENECKS

- A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 5-5; with a minimum of 0.052-inch- (1.3-mm-) thick, galvanized-steel sheet.
- B. Roof Curbs: Galvanized-steel sheet; with mitered and welded comers: 1-1/2-inch (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 12 inches (300 mm)
- C. Bird Screening: Galvanized steel, 1/2-inch- (12.7-mm-) square mesh, 0.041-inch (1.04-mm) wire.
- D. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure intake and relief ventilation to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.
- C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches (230 by 230 mm).
- D. Install intake and relief ventilators with clearances for service and maintenance.
- E. Install perimeter reveals and openings of uniform width for sealants and joint fillers as indicated.
- F. Install concealed gaskets, flashings, joint fillers and insulation as installation progresses. Comply with Section "Joint Sealants" for sealants applied during installation.
- G. Label intake and relief ventilators according to requirements specified in Specification Section "Mechanical Identification."
- H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- I. Repair finishes damaged by cutting, welding, soldering and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Mechanical Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 23 8561

AIR FILTERS

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 factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 SUBMITTALS

- A. Product Data: Include dimensions; shipping, installed, and operating weights; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Include plans, elevations, sections and details to illustrate component assemblies and attachments.
 1. Show filter rack assembly, dimensions, materials and methods of assembly of components.
 2. Include setting drawings, templates and requirements for installing anchor bolts and anchorages.
 3. Wiring Diagrams: Detail wiring for power, signal and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: for each type of filter and rack to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Electronic Air Cleaners and Electrical 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 NFPA 90A and NFPA 90B.
- C. ASHRAE Compliance: Comply with provisions of ASHRAE 52.1 for method of testing and rating air-filter units.
- D. Comply with NFPA 70 for installing electrical components.

1.5 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.
- B. Complete a "minimum" of three (3) complete sets of "construction" filters consisting of standard commercial 2" thick throwaway type filters fiberglass media type filters equal to American Air Filter "5700" Industrial filters shall be provided, installed and maintained prior to initial equipment start up, through construction and until final acceptance of the facility for operation by the Owner.
- C. One complete set of "permanent" filters (the filters indicated to be provided for "permanent" installation in the filter racks, frames, etc. shall be installed, by the Contractor, at time of final acceptance of the air handling units by the Owner. Provide and deliver to the Owner at the project site, one (1) additional complete set of "permanent" filters for each filter rack, frame, etc. Delivery shall occur prior to final acceptance of the air handling systems by the Owner.

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:
 - 1. Air Filters and Filter-Holding Systems:
 - a. AAF International.
 - b. Continental Air Filter Div.; NiCon Filter Corp.
 - c. Farr Co.
 - d. Flanders Filters, Inc.
 - 2. Filter Gages:
 - a. Airguard Industries, Inc.
 - b. Dwyer Instruments Inc.

2.2 DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, viscous-coated, flat-panel type, disposable air filters with holding frames.
- B. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
- C. Frame: Cardboard frame with perforated metal retainer.
 - 1. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
 - 2. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

2.3 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.
- B. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
- C. Media and Media-Grid Frame: Galvanized steel.
- D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.4 EXTENDED-SURFACE, NONSUPPORTED-MEDIA FILTERS

- A. Description: Factory-fabricated, dry, extended-surface, self-supporting filters with holding frames.
 - 1. Media: Fibrous material constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.
 - 2. Filter-Media Frame: Galvanized steel.
 - 3. Duct-Mounting Frames: Welded galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

2.5 AIR HANDLING UNIT MANUFACTURER FRAMES

- A. Refer to Air Handling Unit Specifications and Drawings for Filter Frames to be provided as part of the Air Handling Unit Equipment.

2.6 FRONT- AND REAR-ACCESS FILTER FRAMES

- A. Framing System: Aluminum framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters prevent deflection of horizontal members without interfering with either filter installation or operation.
- B. Prefilters: Incorporate a separate track, removable from front or back.
- C. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.

2.7 SIDE-SERVICE HOUSINGS

- A. Description: Factory-assembled, side-service housings, constructed of galvanized steel, with flanges to connect to duct system.
- B. Prefilters: Integral tracks to accommodate 2-inch/50-mm disposable or washable filters.
- C. Access Doors: Continuous gaskets on perimeter and positive-locking devices. Arrange so filter cartridges can be loaded from either access door.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.8 FILTER GAGES

- A. Description: Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
 - 1. Diameter: 4-1/2 inches.
 - 2. Range: 0- to 2.0-inch wg.
- B. Manometer-Type Filter Gage: Molded plastic with epoxy-coated aluminum scale, logarithmic-curve tube gage with integral leveling gage, graduated to read from 0- to 3.0-inch wg, and accurate within 3 percent of full scale range.
- C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bucket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install filter frames according to manufacturer's written instructions.
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Install filter gage for each filter bank.
- E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling unit installations.
- G. Electrical wiring and connections are specified in Electrical Sections.
- H. 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.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components, filter and filter-frame installation, and electrical wiring. Report results in writing.
- B. Operate automatic roll filters to demonstrate compliance with requirements. Test for leakage of unfiltered air while system is operating. Correct malfunctioning units, then retest to demonstrate compliance. Remove and replace units that cannot be corrected with new units and retest.

3.3 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 26 0005
ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Demolition and removal of selected electrical systems or components installed in portions of building or structure.
 2. Demolition and removal of selected site elements.
- B. Related Sections include the following:
1. Division 1 Section "Summary" for use of premises, phasing, and Owner-occupancy requirements.
 2. Division 1 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
 3. Division 1 Section "Cutting and Patching" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove or Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shut-off, capping, and continuation of utility services.
 4. Means of protection for items to remain and items in path of waste removal from building.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
1. Comply with submittal requirements in Division 1 Section "Construction Waste Management and Disposal."
 2. Dispose of ballasts and lamps in accordance with current EPA Standards.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.6 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.

PART 1 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Arrange to shut off indicated utilities with utility companies.
 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Dispose of demolished items and materials promptly.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer/Architect, items may be removed to a suitable, protected storage location during selective demolition, cleaned, and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA- approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 26 0015
GENERAL CONDITIONS FOR ALL ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including Conditions of the Contract (General and Supplementary Conditions) and Division 1 specification sections, apply to work of this section.
- B. The requirements of this section apply to all sections of electrical, signal, and life safety, and all sections that are installed by the electrical contractor to include electrical work done under the mechanical contractor.

1.2 DESCRIPTION OF WORK

- A. This section covers the general provisions of the electrical specifications applicable to the following systems:
 1. Electrical power and lighting.
 2. Control wiring associated with electrical or mechanical equipment.
- B. The use of the word "electrical" in any specification contained within the electrical, signal, or life safety division sections shall include all aspects of each systems complete install. This shall be extended to mechanical or plumbing signal systems.
- C. The use of the word "life safety" shall refer to all fire alarm, fire protection, and mass notification systems installed by the electrical contractor.
- D. The use of the word "mechanical" shall refer to both mechanical and plumbing.
- E. The use of the word "pipe" shall refer to all electrical raceway.

1.3 DRAWINGS

- A. These specifications are accompanied by drawings of the building and details of the installations showing the locations of equipment, lighting, panels, etc. The drawings and these specifications are complementary to each other, and what is called for by one shall be as binding as if called for by both.
- B. Drawings and specification conflicts shall be identified as early as possible to ensure conflict resolution prior to installation. The contractor shall not install any equipment with known conflicts or pending information requests. The contractor shall contact the Engineer of Record or their representative for information clarification prior to installing any item that is in question. The contractor shall not install any equipment that is not consistent with the manufacturers approved installation instructions unless directed by the engineer.
- C. In all cases all installations shall be at least in accordance with all the approved codes and their local amendments. The drawings and specifications may exceed local code allowances and the most stringent applies. The existence or allowance of a practice or product by code does not supersede requirements of the drawings and specifications. In other words, just because it is allowed by code does not mean that it is allowed on this project.
- D. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Owner's Representative for approval. No departures shall be made without prior written approval by the Owner's Representative.
- E. There are intricacies of construction which are impractical to specify or indicate in detail; however, in such cases, the current rules of good practice and applicable specifications shall govern. In all cases the requirements specified in the NEC and local jurisdiction shall be followed.
- F. It is the Contractor's responsibility to properly use all information found on the Architectural, Structural, Mechanical, and Electrical drawings and applicable shop drawings where such

information affects his work. The contractor shall review the entire construction document set both prior to bid and construction.

- G. All dimensional information related to new structures shall be taken from the appropriate drawings. All dimensional information relative to existing facilities shall be taken from actual measurements made by the Contractor on the site.
- H. Any installation that is not in compliance with these requirements shall be corrected at the contractors cost and responsibility.

1.4 BIDDING

- A. The contractor is responsible for bidding complete and working systems. In the event that some part of the system is not included in the construction document or the specifications and it is a necessary part of the system to work properly, the contractor shall include that work as part of the bid amount.
- B. The contractor is not responsible for interpreting additional accessory options that are not included in the drawings or specifications or equipment that is not shown or indicated as part of the entire contract documents or specifications.
- C. The contractor shall review the entire set of specifications and contract documents for all equipment and connections requiring electrical work.
- D. Equipment Substitutions or Proposed Equivalents:
 - 1. Contractor shall submit proposed substitutions or equivalents to the Architect or engineer during the bidding process prior to any final dates for questions as indicated on the bid forms or RFP's and provide a reasonable time to complete to comparison. All changes to the documents indicated a deviation from the specifications or drawings shall be part of the addenda process or written notification from the engineer of record, architect, owner, or a designated representative. Reasonable time for review is minimum one working week. The contractor shall retain the written notification of approval (if not published in an addenda) for purposes of future verification.
 - 2. The contractor is responsible for providing full comparison information for the products to be substituted. Incomplete information is subject to immediate rejection.
 - 3. Bids taken for equipment that is not approved is under the contractor's own risk. Should the equipment be rejected under the post bid submittal process, the contractor is responsible for providing the specified equipment at no cost to the owner.
 - 4. Under no circumstances should the contractor accept bids for non-specified equipment from vendors who do not have prior approval or "speculate" that it will be approved. This is subject to immediate rejection and the specified equipment shall be required to be installed.
 - 5. No response from the architect, owner, or engineer shall not be considered an approval.

1.5 CONSTRUCTION REQUIREMENTS

- A. The architectural, structural, and electrical plans and specifications and other pertinent documents issued by the Architect are a part of these specifications and the accompanying electrical drawings and shall be complied with in every respect. All the above is included in the Contract Documents and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation because architectural, structural, or mechanical details were not included in the electrical drawings.
- B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to comply with Codes, to facilitate the work of other trades, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated satisfactory operating installation.
- D. The mechanical, electrical, and associated drawings are necessarily diagrammatic in character and do not show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. It shall be the contractor's responsibility to coordinate with other disciplines to facilitate their equipment installation.
- E. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- F. Conduit and equipment are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The plans do not show all required offsets, elbows, and other location details. Work shall be concealed in all finished areas. Conduit is intended to be installed with factory fittings or bent in a professional, workmanlike manner.
- G. All parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. The trade furnishing the equipment shall be responsible for notifying the Contractor, who shall notify the Owner's Representative prior to ordering same in the event that equipment specified and/or proposed is incompatible with this requirement.
- H. Location of Lighting and Outlets in Rooms:
 - 1. All lighting, plumbing, acoustical tile, modular lighting outlets, diffusers, sprinkler heads, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical outlets and electrical lighting and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furring's, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the centers of whole tiles. The final determination of the exact location of each outlet and the arrangements to be followed shall be acceptable to the Owner's Representative.
 - 2. The drawings show diagrammatically the locations of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, equipment drawings, roughing-in drawings, etc. by measurements at the building, and in cooperation with the other trades. The Owner reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner or the Architect. Contractor shall coordinate work with architectural reflective ceiling plan.
- I. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete and in good working order. If any of the requirements of the plans and specifications are impossible of performance, or if the installation when made in accordance with such requirements will not perform

satisfactorily, he shall report same to the Owner's Representative for correction promptly after discovery of the discrepancy.

- J. No extra compensation will be allowed for extra work or change caused by failure to comply with the above requirements.

1.6 JOB CONDITIONS

- A. Submittal of bid implies bidder has read paragraphs of the specifications and will be bound by their conditions.
- B. Contractor Qualifications: A minimum of five years' experience installing commercial electrical power lighting and special systems, similar to those described in these specifications, and make available at the owner or engineer's request a list of five previous projects including name of project and contact person names and phone numbers as a separate document in addition to the bid or proposal submitted.
- C. Contractor must be licensed and hold a current contracting license that has been valid for a minimum of five years in the local State.
- D. Contractor must be able to bond work for performance of work being bid and provide a written statement from the bonding agency proposed to be used for this project as a separate document in addition to the bid or proposal submitted. The bonding agency proposed to be used shall have a Best's insurance rating of A or A+.

1.7 INSPECTION OF THE SITE

- A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, structures, utilities, equipment, systems, facilities, and local requirements. The submission of bids shall be deemed evidence of such visits. All proposals shall take these existing conditions into consideration, and the lack of specific information shall not relieve the Contractor of any responsibility.

1.8 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

- A. Fees and Costs: The contractor shall obtain and pay for all permits, utility connections, utility extensions, and/or relocations and pay all costs required by the utility, including inspection fees, for all work included therein.
- B. Compliance: The Contractor shall comply in every respect with all requirements of local inspection departments, Board of Fire Underwriters, local ordinances and codes, and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these specifications and drawings where specified conditions are of a higher quality than the requirements of the above-specified offices. Where requirements of the specifications and drawings are below the requirements of the above offices having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above offices.
- C. Utilities: The Contractor shall check with the various utility companies involved in this project and shall provide complete in all respects the required utility relocations, extensions, modifications, and/or changes. Contractor shall verify the location of all existing utilities with the applicable Utility Company. The Contractor shall be responsible for all damages to existing utilities caused by his construction work, whether indicated on drawings or not, and repair all damage to existing utilities as acceptable to the Utility Company concerned.
- D. Utility Services:
 1. Power for the building service shall be obtained from local utility service. Contractor shall coordinate with the local utility for shutdowns and transformer installations. Contractor shall coordinate underground feeders with other underground piping and mark his conduit clearly. Contractor shall install feeders to the building transformer in accordance with utility company requirements.
 2. Contractor shall coordinate meter location and provide access in accordance with local utility requirements.

- E. Certification: Prior to final acceptance, the Contractor shall furnish a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract. Any additional labor costs incurred as a result of a substitution shall be the Contractor's responsibility.

1.9 EXISTING FACILITIES

- A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection, and in-service maintenance of all electrical and special systems for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work. Barricades shall clearly indicate with signage that which they are protecting. Contractor shall observe all OSHA rules.
- B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
- C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, and equipment, etc. to provide this access and shall reinstall same upon completion of work in the areas affected.
- D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall in locations approved by the Architect/Engineer all devices required for the operation of the various systems installed in the existing construction. This is to include but is not limited to temperature controls system devices, electrical switches, relays, fixtures, piping, conduit, etc.
- E. Outages of services as required by the new installation will be permitted but only at a time approved by the Owner. The Contractor shall allow the Owner two weeks in order to schedule required outages. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount. Unless otherwise scheduled by the Owner, planned shutdowns of the existing facilities shall occur between 6 p.m. Friday through 5 am Monday. The existing building shall be ready for morning start-up by 5 am Monday.

1.10 SUBMITTAL DATA

- A. General: As soon as practical and within 30 days after the date of award of contract and before purchasing or starting installation of any materials or equipment, the Contractor prepare or cause to be prepared shop drawings, product data, materials and equipment lists, diagrams, data, samples, and other submittals as required by the contract documents, hereinafter referred to as "Submittal Data." The Contractor shall review and approve all submittal data for compliance with the contract documents, manufacturer's recommendations, adequacy, clearances, code compliance, safety, and coordination with associated work.
- B. The Contractor shall submit approved submittal data to the Owner's Representative for review and comment as to general conformance with the design concept and general compliance with information given in the contract documents. Owner's Representative's review shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with other trades or work, or construction safety and precautions, all of which are the sole responsibility of the Contractor. The reviewers shall make every effort to "catch" discrepancies and identify these to the contractor prior to ordering equipment. However, it shall remain the contractor's responsibility to order and install the equipment as listed in the drawings and specifications. At the owner's representative's discretion a detailed submittal may be required.

- C. Substitutions shall be clearly identified as such in the submittal by a cover sheet indicating that items are different from what is specified or scheduled. It shall be the contractor responsibility to provide complete substitution information so an accurate comparison can be made.
- D. Detail Submittals: Materials and equipment requiring detailed submittal data shall be submitted with sufficient data to indicate that all requirements of the specifications have been met and samples shall be furnished when requested. All manufacturer's data used as part of the submittal shall have all non-applicable features crossed out or deleted in a manner that will clearly indicate exactly what is to be furnished. The detailed submittals shall be accompanied by the same number of sets of pictorial and descriptive data derived from the manufacturer's catalogs and sales literature or incorporated in the shop drawings. The Contractor may provide a detailed submittal on any item even though not required by the Owner's Representative.
- E. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.
- F. The Contractor shall clearly and specifically identify and call to the attention of the Owner's Representative any deviation from the contract documents for which Owner acceptance is desired. The responsibility for such a deviation accepted by the Owner shall remain with the Contractor.
- G. Timeliness: The burden of timeliness in the complete cycle of submittal data is on the Contractor. The Contractor shall allow a minimum of four (4) weeks' time frame for the submittal cycle of each submission by the Owner's Representative. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all re-submission cycles on non-conforming materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not justify any request for scheduled construction time extensions or extra compensation.
- H. Work performed in accordance with approved submittal data that is not in accordance with the Contract Documents and did not have the specific acceptance of the Owner's Representative shall be replaced at Contractor's cost.
- I. Submittals shall be provided in the following format:
 1. The submittal brochures shall be in pdf format. The first page shall be titled "ELECTRICAL SUBMITTAL INFORMATION" and shall list the name and location of project, the Owner, the Engineer(s), the General Contractor, and the Subcontractors installing equipment represented in the brochure.
 2. A table of contents will follow the first page and shall list all of the sections contained in the specification manual. Each section will be tabbed and will include its' respective brochures. All brochures will be three-hole punched and folded (if required). Each submittal section will correspond to the appropriate specification section number.
 3. Provide submittal data for all materials to be used on this project as indicated in each specification manual section.
 4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.
 5. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.

6. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
 7. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner, Architect, or Engineer. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer.
 8. Submittal shall have the certification information as listed hereafter.
 9. Submittal data for each section must be complete. Partial submittals, or submittals not in the specified format, will be rejected and returned to the Contractor without further review.
- J. All equipment installed on this project shall have **local (within 125 miles)** representation, local factory-authorized service, and a local stock of repair parts. This requirement is essential and will be strictly reviewed by the Owner's Representative prior to concurrence with the Contractor's approval for all submittals covered by electrical division sections.
- K. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of approved manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- L. These paragraphs related to electrical divisions submittal data rescind, amend, and supersede any provisions to the contrary contained in the Project Manual.

1.11 CERTIFICATION OF SUBMITTAL DATA

- A. The Contractor shall provide the following certification with all submittal data furnished to the Owner's Representative for review and comment.

Project Title:

Description of Submittal Data:

This is to certify that the above-described submittal data has been reviewed and is approved for compliance with the Contract Documents, manufacturer's recommendation, adequacy, clearances, code compliance, safety, and coordination with other trades and/or work except as follows: (list "none" or itemize and explain). In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

EXCEPTIONS:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

Name and Company

1.12 ACCEPTANCE OF MATERIALS AND EQUIPMENT

- A. Owner's Manual: After the submittals have been accepted the Contractor is requested to include a minimum of three (3) additional copies for insertion in the project's Owner's Manuals at the completion of the project.
- B. **NOTICE: The Contractor is responsible for providing materials and equipment that conform to the requirements of the project manual in every respect unless a deviation**

has been “accepted” in writing. Removal of any nonconforming materials and equipment and the replacement with conforming materials and equipment shall be at the Contractor’s sole expense, regardless of when nonconformance was discovered. If the owner or owner’s representative elects to keep the equipment it shall be contractors responsibility to provide any additional connections or services required to make the equipment function as specified or required by the manufacturer. The contractor shall coordinate with other subs for any different material requirements (wire size, breakers, cooling, mounting requirements, etc.).

- C. Approval of materials and equipment shall be based on manufacturer’s published data and shall be tentatively subject to the submission of complete shop drawings which comply with the contract documents. Approval is also dependent upon the existence of adequate and acceptable clearances for entry, servicing, and maintenance.
- D. Approval of materials and equipment under this provision shall not be construed as authorizing any deviations from the specifications, unless the attention of the Owner’s Representative has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

1.13 SITE OBSERVATION

- A. Site observation by the Architect, Engineer, and/or Owner’s Representative is for the express purpose of verifying compliance by the Contractor with the contract documents, and shall not be construed as construction supervision nor indication of approval of the manner or location in which the work is being performed as being a safe practice or place.

1.14 SUPERVISION

- A. In addition to the Superintendent required under the conditions of the contract, each subcontractor shall keep a competent superintendent or foreman on the job at all times.
- B. It shall be the responsibility of each superintendent to study all plans and familiarize himself with the work to be done by other trades. He shall coordinate his work with other trades and, before material is fabricated or installed, make sure that his work will not cause an interference with another trade. Where interferences are encountered, they shall be resolved at the jobsite by the superintendents involved. Where interferences cannot be resolved without major changes to the plans, the matter shall be referred to the Owner’s Representative for comments.

1.15 OPERATION PRIOR TO COMPLETION

- A. When any piece of electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation and has the written permission of the Owner’s Representative to do so. The contractor shall energize the power distribution in a timely manner to facilitate completion of other trades work. Electrical lighting shall be energized after ceiling has been completed. New permanent fixtures shall not be used as temporary under any circumstances. The warranty period shall not commence, however, until such time as the equipment is operated for the beneficial use of the Owner or date of substantial completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

1.16 MANUFACTURER’S RECOMMENDATIONS

- A. The manufacturer’s published directions shall be followed in the delivery, storage, protection, installation, piping, and wiring of all equipment and material. The Contractor shall promptly notify the Owner’s Representative, in writing, of any conflict between the requirements of the contract documents and the manufacturer’s directions and shall obtain the Owner’s Representative’s comments before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer’s directions or applicable

comments from the Owner's Representative, he shall bear all costs arising in connection with the correction of such deficiencies.

1.17 CHECKING AND TESTING MATERIALS AND/OR EQUIPMENT

- A. Before final acceptance of the work, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of his materials and/or equipment to determine that it is properly installed and in proper operating order. Testing and checking shall be accomplished during the course of the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Owner's Representative a signed statement from each representative certifying as follows:

"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations and are asbestos free."

1.18 OPERATING AND MAINTENANCE INSTRUCTION

- A. The Contractor shall prepare for the owner's manual hereinafter specified complete sets of operating and maintenance instruction's, control and interlock diagrams, manuals, parts lists, etc. for each item of equipment. These are to be assembled as hereinafter specified for owner's manual.
- B. In addition, the Contractor shall provide the service of a competent engineer or a technician acceptable to the Owner's Representative to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of sufficient duration to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, acknowledged by the Owner, stating the dates of instruction and personnel to whom instructions were given.
- C. Additional diagrams, operating instructions, etc. shall be provided as specified hereinafter in the other sections of these specifications.

1.19 MATERIAL AND EQUIPMENT SCHEDULES

- A. Contractor shall refer to both drawings and specification for schedules. Where reference is made to items "scheduled on drawings" or "scheduled in specifications," same shall include schedules contained in both the drawings and the specifications. The Contractor's attention is directed to the various specification sections and drawings for schedules.

1.20 APPLICABLE CODES AND STANDARDS

- A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of these specifications, except as may be hereinafter specifically modified in these specifications and associated drawings.
1. National Fire Protection Association Standards (NFPA):
 - a. NFPA No. 10, Portable Fire Extinguishers
 - b. NFPA No. 54, National Fuel and Gas Code
 - c. NFPA No. 70, National Electrical Code
 - d. NFPA No. 101, Life Safety Code
 - e. NFPA No. 255, Method of Test of Surface Burning Characteristics of Building Materials
 2. American National Standards Institute (ANSI):
 3. American Society of Mechanical Engineers (ASME): Section IV, V, CSD-1
 4. American Society of Testing Materials (ASTM): All applicable manuals and standards.
 5. National Electrical Manufacturers' Association (NEMA): All applicable manuals and standards.
 6. State Occupational Safety Act: All applicable safety standards.
 7. Occupational Safety and Health ACT (OSHA): National Sanitation Foundation, Standard No. 2

8. Americans with Disabilities Act, 1990
 9. State jurisdiction Accessibility Standards
 10. American Gas Association (AGA)
 11. Underwriters Laboratories, Inc. (UL)
 12. Applicable State Building Codes (Uniform Building Codes, as amended):
 13. All County codes related to mechanical, electrical, plumbing, and system equipment; piping; conduit; wiring; etc. furnished and installed under these specifications.
 14. All City ordinances related to mechanical, electrical, plumbing, and systems and equipment; piping; conduit; wiring; etc. furnished and installed under these specifications.
 15. Refer to specification sections heretofore bound for additional codes and standards.
- B. All materials and workmanship shall comply with all applicable city, state, and national codes, specifications, and industry standards. All materials shall be listed by the Underwriters Laboratories, Inc. as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.
- C. The contract documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately notify the Owner's Representative in writing of said discrepancies and apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by Division 1 of these contract documents, providing no work or fabrication of materials has been accomplished in a manner of noncompliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules, and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.21 DEFINITIONS

- A. Refer to the condition of the contract for Division 1 for additional requirements regarding definitions.
- B. Where "as required" is used in these specifications or on the drawings, it shall mean "that situations exist that are not necessarily described in detail or indicated that may cause the Contractor certain complications in performing the work described or indicated. These complications entail the normal coordination activities expected of the Contractor where multiple trades are involved and new or existing construction causes deviations to otherwise simplistic approaches to the work to be performed. The term shall not be interpreted to permit an option on the part of the Contractor to achieve the end result."
- C. Where "and/or" is used in these specifications or on the drawings, it shall mean "that situations exist where either one or both conditions occur or are required and shall not be interpreted to permit an option on the part of the Contractor.
- D. Unless specifically indicated otherwise elsewhere in these specifications or on the drawings the word "furnish" or any of its derivatives shall be understood to indicate the purchase, delivery, storage and protection of an item at the job site in a location and manner suitable for use by the recipient who will be responsible for installation of this item. The word "install" or any of its derivatives shall be understood to indicate taking receipt of an item, properly mounting it, and providing the related utilities (electrical, communication, etc.) for proper and complete operation of the item. Installation shall also include calibration, programming and operational testing of said item. The word "provide" or any of its derivatives shall be understood to indicate both furnishing and installing an item.

1.22 SUBSTANTIAL COMPLETION

- A. Refer to Division 1 for additional requirements for substantial completion.
- B. Substantial completion shall be defined as the level of project completion where the owner is ready to occupy the building. The contractor shall have ensured that all mechanical,

electrical, plumbing, and building systems (elevators, automatic doors, hardware, security, etc.) are complete and in fully functional working order. This level of completion does not absolve the contractor from the requirements of final inspection or final acceptance. The contractor shall ensure there are no life safety issues unresolved with the project at the time of substantial completion.

- C. All "punch" list items shall have been resolved or shall be identified as pending resolution. Items listed as unresolved shall be either pending information or direction from the owner or owner's representative or shall be awaiting parts or supplies that are "on order". The contractor at the owner's discretion shall produce documentation of the part or supply on order status.

1.23 FINAL INSPECTION

- A. Refer to Division 1 for additional requirements for final inspection.
- B. It shall be the responsibility of the Contractor to personally conduct a careful inspection, assuring himself that the work on the project is ready for final acceptance and developing his own "punchlists," before calling upon the Owner's Representative to make a final inspection. Failure of the Contractor to conduct such inspections and provide the Owner's Representative with a copy of his "punchlists" prior to the final inspection shall be adequate cause for the Owner's Representative to cancel any Contractor-requested final inspection.
- C. In order not to delay final acceptance of the work, the Contractor shall conduct his own "final inspections" prior to requesting the Owner's Representative to "final" the project; will have all necessary bonds, guarantees, receipts, affidavits, etc. called for in the various articles of this specification prepared and signed in advance; and together with a letter of transmittal listing each paper included, shall deliver the same to the Owner's Representative at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc. before preparing same for submission to see that the terms check with the requirements of the specifications.
- D. The final inspection will be made jointly by the Owner's Representative and the Owner.

1.24 REQUIREMENTS FOR FINAL ACCEPTANCE

- A. Requirements for final acceptance shall include but not be limited to the Contractor accomplishing the following:
1. Construction: Complete all construction.
 2. Deficiency Lists: Correct all deficiencies listed at time of Substantial Completion.
 3. Owner's Manual: Submit at least 30 days prior to final acceptance one (1) copy of the owner's manual for the Owner's Representative's review and comments. Following acceptance, prepare three (3) copies of bound and indexed owner's manual, to be delivered at the time of final acceptance, which shall include but not be limited to the following:
 - a. System operating instructions.
 - b. System control drawings.
 - c. System interlock drawings.
 - d. System maintenance instructions.
 - e. Manufacturers', suppliers', and subcontractors' names, addresses, and telephone numbers, both local representatives and manufacturers' service headquarters.
 - f. Equipment operating and maintenance instructions and parts lists.
 - g. Manufacturers' certifications (see Checking and Testing Materials and/or Equipment, this section).
 - h. Contractor's warranty.
 - i. Acceptance certificates of authorities having jurisdiction.
 - j. Log of all tests made during course of work.
 - k. Owner's acknowledgment of receipt of instruction, enumerating items in owner's manual.

- I. List of manufacturers' guarantees executed by the Contractor.
- m. Owner's acknowledgment of items of equipment or accessories indicated or specified to be turned over to Owner.
4. Instructions:
 - a. Verbal, as herein specified.
 - b. Posted, framed under glass or plastic laminated:
 - 1) System operating instructions.
 - 2) System control drawings.
 - 3) System interlock drawings.
5. Record Drawings: Deliver the specified record drawings to the Owner's Representative.

1.25 RECORD DRAWINGS

- A. The Contractor shall maintain a set of contract drawings at the job site on which he shall indicate the installed locations of all equipment, electrical lighting, data drops, fire alarm devices, PA system devices, security devices, outlets, and electrical feeders. These drawings shall be used for reference or construction and shall not leave the field office. Upon completion of the work, the Contractor shall obtain and pay for Mylar's and/or disks (if available as CAD files) of the contract drawings from the Owner's Representative and transfer the above information to these Mylar's to provide "Record Drawings." The above-mentioned prints and "Record Drawings" shall then be delivered to the Owner's Representative. Refer to paragraph entitled "Record "Drawings" of the Supplemental General Conditions.

1.26 WARRANTY

- A. General: All work performed (including equipment and materials furnished) under the various sections of these specifications shall be 100% warranted, for a period of one (1) year from the date of substantial completion thereof, against defective materials, design, and unauthorized substitution. Upon receipt of note of failure of any part of the guaranteed equipment and/or facilities during the guaranty period, the affected part(s) or facilities shall be replaced promptly with new parts, etc. by and at the expense of the Contractor. Further, the Contractor shall properly obtain, execute, and forward any and all manufacturer's warranties on equipment furnished under the Contract. Refer to Division 1 for additional requirements.

PART 2- PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

- A. All materials, unless otherwise specified, shall be current United States manufacture, new, free from all defects, and of the best quality. Foreign goods specifically approved for use by the Owner's Representative prior to bidding may be furnished.
- B. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by electricians skilled in their respective trades, and the installations shall present a neat, precise appearance.
- C. The responsibility for the furnishing and intended installation of the proper electrical equipment and/or material as intended rests entirely upon the Contract. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

2.2 MATERIAL AND EQUIPMENT REQUIREMENTS

- A. Manufacturer's Instructions: The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer materials or equipment, unless otherwise indicated. The Contractor shall promptly notify the Owner's Representative in writing of any conflict between the requirements of the Contract Documents and the manufacturer's direction and shall obtain the clarification of the Owner's Representative before proceeding with the work. Should the Contractor perform any such

- work that does not comply with the manufacturer's directions or such clarification by the Owner's Representative, he shall bear all costs arising in connection with the correction of the deficiencies.
- B. Storage at Site: The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage from surrounding work. All new or relocated equipment shall be stored inside or protected from the environment. Equipment that is not properly stored shall be replaced by the contractor at no cost to the owner.
 - C. Capacities shall be not less than those indicated and shall be such that no component or system becomes inoperative or is damaged because of startup or other overload conditions.
 - D. Conformance to Agency Requirements: Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriters Laboratories, Inc., or constructed and/or tested in accordance with the standards as listed in the NEC, the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. The label of the Underwriters Laboratories, Inc. applied to the item will be acceptable as sufficient evidence that the items conform to such requirements.
 - E. Nameplates: Each major component of equipment shall have the manufacturer's name, address, and model-identification number embossed on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection. All equipment starters and disconnects shall be tagged with the equipment designated mark and circuit.
 - F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark. Where rust inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable unless a specific coating is specified, except that coal tar or asphalt-type coatings will not be acceptable unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-26915.
 - G. Protection of Connections: Switches, breaker handles, keys setscrews, handles and other parts not listed for normal occupied operation (light switches, etc.) shall be located accessible to but out of paths to prevent their accidental shutoff.
 - H. Verifications of Dimensions: The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Owner's Representative of any discrepancy before performing any work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner, Architect, or Engineer.
 - I. Standard Products: Materials and equipment to be provided shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two years.

2.3 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. No substitution of materials or equipment herein specified or called for on the drawings will be permitted, except by written permission of the Owner's Representative. Where several makes of equipment or material are mentioned, any item named may be bid upon provided it meets space, capacity specifications, finish, usage (switching, ballasts, similar operation), and looks and functions as what was specified.

- B. Do not submit substitutions that do not match in whole what was specified or scheduled. Deviations from scheduled or specified items are installed at the contractor's risk and are subject to replacement if the owner/engineer deems the product different from the specified item.
- C. If the specified item is no longer available, it is the contractors responsibility to contact the architect/engineer and notify that the item is not available and suggest a suitable substitution that matches in whole the form, function, and appearance of the scheduled or specified item.
- D. Refer to Conditions of the Contract and Division 1 for additional requirements regarding substitutions.

2.4 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

- A. Plenum cable, conduit, insulation, equipment support and mounting hardware, tapes, adhesives, core materials, jackets, and other materials in concealed locations, including any above-ceiling area, shall have a flame spread rating not over 25 without evidence of continued progressive combustion and a smoke developed rating no higher than 50. Flame spread and smoke developed ratings shall be in accordance with NFPA Standard No. 255.

2.5 SLEEVES, INSERTS, AND FASTENINGS

- A. General: Proper openings through floors, masonry walls, roofs, etc. for the passage of conduits shall be provided. All conduit through floors and walls must pass through sleeves, except conduit that is cast-in-place. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Owner's Representative.
- B. Materials: Sleeves shall be of standard weight galvanized iron pipe, except heavy-gauge galvanized iron sleeves may be utilized in concrete pours where acceptable to the Owner's Representative for size and metal gauge. Sleeves in fittings, grade beams, and where pipes enter or leave the building or pass through concrete or masonry shall be Schedule 40 PVC along the pipe route from the underground installation to the insulating coupling installed above ground.

2.6 ACCESS DOORS

- A. General: Provide wall, ceiling, or duct access doors for unrestricted access to all concealed items of electrical equipment.
- B. Manufacturers shall be Inland-Milcor, Bilco, Miami Carey, or approved equal.
- C. UL labeled when in fire-rated construction, one and one-half hour rating.
- D. Equipment access doors shall be of sufficient size to remove/replace equipment and provide routine maintenance as necessary, unless otherwise noted. All doors shall have wedge-type latches except where cylinder locks are otherwise indicated or specified. Doors shall be set flush with adjacent finish surfaces. Exterior doors shall be provided with cylinder locks.
- E. Access doors into ductwork shall be 14-gauge insulated galvanized steel with 16-gauge galvanized gasketed steel frame and cam-type locks. Access door shall be a minimum of 12" x 12" in size.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the electrical systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

PART 3 - EXECUTION

3.1 SPACE AND EQUIPMENT ARRANGEMENTS

- A. The size of electrical equipment indicated on the drawings is based on the dimensions of a particular manufacturer. While other manufacturers will be acceptable, it is the responsibility of the Contractor to determine whether the equipment he proposes to furnish will fit in the

space. Shop drawings shall be prepared when required by the Owner's Representative to indicate a suitable arrangement.

- B. All equipment shall be installed in a manner to permit access to all surfaces.

3.2 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.3 PROTECTION

- A. The Contractor shall take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the uncompleted building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- B. The Contractor shall protect existing facilities, the work of others, and the premises from any and all damages that may be made possible by the execution of work.
- C. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these specifications.

3.4 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

- A. Each trade, subcontractor, and/or Contractor must work in harmony with the various trades, subcontractors, and/or Contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or Contractor must pursue its work promptly and carefully so as not to delay the general progress of the job. This Contractor shall work in harmony with Contractors working under other contracts on the premises.
- B. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the jobsite in a clean and safe condition. At the end of each day's work, each trade shall properly store all of its tools, equipment, and materials and shall clean its debris from the job. Upon the completion of the job, each trade shall immediately remove all of its tools, equipment, any surplus materials, and all debris caused by its portion of the work.

3.5 PRECEDENCE OF MATERIALS

- A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each subcontractor and/or trade shall be responsible for the proper fitting of his material and apparatus into the building.
- B. The work of the various trades shall be performed in the most direct and workmanlike manner without hindering or handicapping the work of other trades. Piping interferences shall be handled by giving precedence to pipe lines which require a stated grade for proper operation. Where space requirements conflict, the following order or precedence shall, in general, be observed:
1. Building lines.
 2. Structural members.
 3. Soil and drain piping.
 4. Condensate drains.
 5. Vent piping.
 6. Supply, return, and outside air ductwork.
 7. Exhaust ductwork.
 8. HVAC water piping.

9. Natural gas piping.
10. Domestic water (cold and hot).
11. Refrigerant piping.
12. Electrical conduit.

3.6 CONNECTIONS FOR OTHERS

- A. This Contractor shall rough-in for and make all electrical connections to all fixtures, equipment, machinery, etc. provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
- B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required conduit, fittings, whips, connectors, etc.
- C. The Mechanical Contractors will set in place, ready for connection, all motors to be provided under their Contracts. The Mechanical Contractors will furnish and deliver all starter and control equipment not shown in motor control centers for any motors which they furnish. The Mechanical Contractor shall be responsible for the complete installation of all automatic temperature control systems, including wire, conduit, and interlocking connections.
- D. The Electrical Contractor shall connect all motors and shall set in place all control devices, furnishing supports if and as necessary, and shall furnish and install all interconnecting line voltage wiring and make all connections ready for operation between motors, starters, and disconnect switches, as required. The Electrical Contractor shall furnish and install all motor control centers, including breakers, starters, etc. The Contractor shall refer to the Mechanical drawings and specifications for his scope of the connections to equipment furnished under these Contracts.

3.7 INSTALLATION METHODS

- A. Where to Conceal: All conduits shall be concealed in chases, walls, furred spaces, below suspended floors, or above the ceilings of the building unless otherwise indicated. All concealed conduit shall be run in a professional manner, and parallel or perpendicular to the building lines.
- B. Where to Expose: In mechanical rooms, only where necessary, conduit may be run exposed. All exposed conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines. Conduit shall be bent in a manner as to run parallel to other conduits and not cross at angles.
- C. Support: All conduit shall be adequately and properly supported from the building structure by means of hangers or clamps to walls as herein specified.
- D. Maintaining Clearance: Where limited space is available above the ceilings and below concrete beams or other deep projections, conduit shall be sleeved through the projection where it crosses, rather than hung below them, in a manner to provide maximum above-floor clearance. Sleeves shall be as herein specified. Approval shall be obtained from the Owner's Representative for each penetration.
- E. All conduits, etc. shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit openings shall be kept closed until the systems are closed with final connections.
- F. Special Requirements:
 1. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Owner's Representative and resolve the conflict prior to erection of any work in the area involved.

2. All conduit not directly buried in the ground or installed outside shall be considered as "interior."
3. Prior to the installation of any ceiling material, gypsum, plaster, or acoustical board, the Contractor shall notify the Owner's Representative so that arrangements can be made for an inspection of the above-ceiling area about to be "sealed off." The Contractor shall give as much advance notice as possible up to ten (10) working days, but in no case less than five (5) working days.
4. The purpose of this inspection is to verify the completeness and quality of the installation of the electrical systems and any other special above-ceiling systems, such as data, fire alarm, security. The ceiling supports (tee bar or lath) should be in place so that access panel and light fixture locations are identifiable and so that clearances and access provisions may be evaluated.
5. No ceiling material shall be installed until the deficiencies listed from this inspection have been corrected to the satisfaction of the Owner's Representative.

3.8 CUTTING AND PATCHING

- A. General: Cut and patch walls, floors, etc. resulting from work in existing construction or where made necessary by failure to provide proper openings or recesses in new construction.
- B. Methods of Cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Owner's Representative. Impact-type equipment will not be used except where specifically acceptable to the Owner's Representative. Openings in concrete for pipes, conduits, outlet boxes, etc. shall be core drilled to exact size. **Determine location of embedded conduit and reinforcing bars prior to cutting.**
- C. Restoration: All openings shall be restored to "as-new" condition under the appropriate specification section for the materials involved, and shall match remaining surrounding materials and/or finishes.
- D. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc. shall be of the proper size and shape, and shall be installed in a manner acceptable to the Owner's Representative.
- E. Plaster: All mechanical work in area containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- F. Weakening: No cutting, boring, or excavating which will weaken the structure shall be undertaken.

3.9 SLEEVES, INSERTS, AND FASTENINGS

- A. Sleeves: The minimum clearance between horizontal conduit and sleeve shall be $\frac{1}{4}$ inch, except that the minimum clearance shall be $\frac{1}{2}$ inch where piping contacts the ground. Sleeves through floors shall extend $\frac{3}{4}$ inch above the floor; sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves are not required for piping indicated to the cast-in-concrete slabs-on-fill.
- B. Inserts: Suitable concrete inserts for conduit and equipment hangers shall be set and properly located for all conduit and equipment to be suspended from concrete construction.
- C. Fasteners: Fastening of pipes, conduits, etc. in the building shall be as follows:
 1. To wood members: by wood screws.
 2. To masonry and concrete: by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry or concrete.
 3. To steel: machine screws or welding (when specifically permitted or directed), or bolts.
- D. Weatherproofing: The annular space between a conduit and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50% greater in

diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor with a fire-resistant sealant.

3.10 FIRE AND SMOKE PARTITION, WALL, AND/OR FLOOR PENETRATIONS

- A. Conduit passing through fire- or smoke-rated floors, partitions, walls, or other barriers within a UL-listed assembly which shall maintain the rating of the applicable wall, floor, partition, or barrier. Flexible conduit shall not be used in rated walls. Provide connections between "hard" pipe and flexible whips on either side of wall. Fireproof around conduits.
- B. The Contractor shall review the architectural and structural drawings and determine the location of the fire-rated building elements. Where these elements are penetrated, UL-listed fire-rated penetration assemblies approved by the local authority shall be provided in accordance with the manufacturer's instructions to obtain the required rating.

3.11 CONDUIT SUPPORT

- A. Conduit Support: All conduits throughout the building, both horizontal and vertical, shall be adequately supported from the construction to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage. Vertical conduits shall be supported from floor lines with riser clamps sized to fit the lines and to adequately support their weight. At the bases of lines, where required for proper support, provide anchor base fittings or other approved supports.
- B. Conduit shall not be supported from any other system.

3.12 HANGERS

- A. General: Each hanger shall be properly sized to fit the supported pipe or to fit the outside of the insulation on lines where specified.
- B. Attachment:
 1. The load on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete which holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
 2. Where pipes are supported under steel beams, approved-type beam clamps shall be used.
 3. Where conduit is supported under wood joists, hanger rods shall be attached to joists with side beam brackets or angle clips.
- C. Spacing: All hangers shall be so located as to properly support horizontal lines without appreciable sagging of these lines. All PVC shall be supported at intervals recommended by the manufacturer, or as otherwise specified or indicated.
- D. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on trapezes of Kindorf, Elcen, or approved equal, channel-suspended on rods or pipes. Trapeze members including suspension rods shall each be properly sized for the number, size, and loaded weight of the lines they are to support.
- E. Ceiling-Mounted Devices: All lighting and devices or assemblies mounted in lay-in-type ceilings and which are supported by the ceiling grid, directly or indirectly, and which weigh in excess of 2 lbs., shall be provided with at least two 12-gauge minimum wire supports connected securely between the device or assembly and the structure, to serve as a safety support in the event of the collapse of or a disturbance in the support of the ceiling system that might cause the device or assembly to fall through the ceiling. This includes, but is not limited to, light fixtures, J-boxes, and heavy speakers. Provide additional support as required where the weight of the device or assembly will exceed the safe limits of the wire supports.
- F. Perforated strap iron or wire will not be acceptable as hanger material.
- G. Miscellaneous: Provide any other special foundations, hangers, and supports indicated on the drawings, specified elsewhere herein, or required by conditions at the site. Hangers and

supporting structures for suspended equipment shall be provided as required to support the load from the building structure in a manner acceptable to the Owner's Representative.

3.13 ACCESS DOORS

- A. Provide in walls, floors, and ceilings to permit access to all equipment and piping requiring service or adjustment. Examples of such equipment needing access are disconnects, actuators, contacts, and equipment needing periodic or replacement maintenance.
- B. Use panels equal to Milcor Style M for masonry and drywall construction, equal to Milcor Style K for plastered masonry walls and ceilings. Stainless steel panels shall be used in ceramic tile or glazed structural tile.
- C. Access doors located outside or in a moisture-laden environment (e.g., toilet room, dressing area, shower area, etc.) shall be stainless steel.

3.14 TESTS AND INSPECTIONS

- A. Refer to conditions of the contract and Division 1 for additional requirements regarding tests and inspections.
- B. General: The Contractor shall make all tests deemed necessary by the inspection departments of the authority having jurisdiction, Board of Underwriters, etc. He shall provide all equipment, materials, and labor for making such tests. Fuel and electrical energy for system operational tests following beneficial occupancy by the Owner will be paid for by the Owner.
- C. Other: Additional tests specified hereinafter under the various specification sections shall be made.
- D. Notification: The Owner's Representative shall be notified at his office 36 hours prior to each test and other specifications requirements requiring action on the part of the Owner, Architect, Engineer, and/or Owner's Representative.
- E. Test Logs: All tests which the Contractor conducts shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description and extent of system tested, test conditions, test results, specified results, and any other pertinent data. Data shall be delivered to the Owner's Representative as specified under "Requirements for Final Acceptance."
- F. Inspections: In general, an inspection by the Owner's Representative shall be required prior to closing up any work and prior to beneficial occupancy or final project completion. The closing up of work includes, but is not limited to, conduit installations prior to backfilling; electrical and fire protection work prior to placement of concrete; or closing up walls and overhead electrical and fire protection work prior to installation of the ceiling.

3.15 CLEANING AND PAINTING

- A. The contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.
- B. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- C. Exposed metal work which is not galvanized shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean and then painted with a suitable rust resistant primer. Exposed metal work includes work exterior to the building; exposed in mechanical or electrical equipment rooms and storage rooms; and other areas where occupants could see the work, whether normally occupied or not.
- D. All other painting shall be accomplished under the Painting Section of Division 9 of the specifications.

- E. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, switchboards, starters, and other electrical devices. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.16 IDENTIFICATION AND LABELING

- A. General: The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, disconnects, panels, etc. by marking them. All disconnects/starters/panels shall be labeled for the equipment they serve. Marks shall be the same as the drawings.

3.17 COORDINATION OF WORK

- A. The light fixture grid layout as indicated on the drawings must be maintained. This Contractor shall refer to all light fixture plans and details indicated on the drawings.
- B. The electrical trades shall locate all junction boxes, pull boxes, conduits, etc. to avoid interference with the diffusers, dampers, grilles, etc. The mechanical trades shall furnish to all other trades copies of approved ductwork shop drawings to assist in the coordination of the rough-in and installation of all items of work.
- C. The order of space allocation priority in plan and in elevation shall be as follows.
1. 1st Light Fixtures, at Ceiling Soffit + 6"
 2. 2nd Grade Plumbing Waste and Vent Systems
 3. 3rd Ductwork
 4. 4th Pressurized Piping Systems
 5. 5th Electrical Conduit
 6. 6th Ceiling Support System, where required

3.18 DISCHARGE OF WASTES FROM CONSTRUCTION SITE

- A. The Contractor shall comply with all applicable provisions of local, state, and federal laws regarding the discharge of wastes into sewer and waterways. Special caution shall be exercised to prevent the discharge of wastes which contain oil, tar, asphalt, roofing compound, kerosene, gasoline, paint, mud, cement, lime, or other materials which would degrade the water quality of the receiving water course.
- B. Disposal of Lamps and Ballasts: The proper disposal of all ballasts and lamps from the demolition of lighting fixtures as part of this project will be the responsibility of the Electrical Contractor. All lamps and ballasts found to contain hazardous contaminants will be removed from the site and transported to a licensed disposal facility by a contractor licensed in this field. All work shall be performed in accordance with current state and Federal rules and regulations pertaining to the processing of contaminated waste materials. A certificate of proper disposal from the licensed waste contractor shall be provided to the Engineer.

3.19 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each electrical system, piece of equipment, and material installed under this Contract.
- B. The manuals shall be identified on the cover as "Operating and Maintenance Manual" and shall list the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- C. Two (2) copies of the manual, bound in three-ring hardback binders shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance. The manual shall have a Table of Contents and shall be grouped in tabbed sections according to the specification sections. Each section shall be organized as follows:

1. Approved engineering submittals with complete performance and technical data.
 2. Manufacturer's local representative and/or distributor's name and address.
 3. Manufacturer's installation instructions and brochures.
 4. Manufacturer's operating and maintenance brochures.
 5. Manufacturer's installation wiring diagram.
 6. Contractor's field wiring diagram, if different.
 7. Manufacturer's brochure listing recommended spare parts.
 8. Manufacturer's brochure listing replacement part numbers and descriptions.
- D. Provide a final section entitled, "Warranties and Guarantees", for all equipment as well as Contractor's warranty.

3.20 CONDITIONS OF EQUIPMENT AT FINAL ACCEPTANCE

- A. At the time of acceptance, the Contractor shall have inspected all installed systems to assure the following has been completed:
1. Fixtures are operating, and lenses and reflectors are free of dust, debris, and fingerprints.
 2. Panelboards have all conductors neatly formed, bundled, and made-up tight. Cans shall be vacuum cleaned and surfaces cleaned of stray paint, dust, grease, and fingerprints. All circuit directories to be neatly typed and in place.
 3. Wall plates and exposed switch and receptacle parts to be clean, free of paint, plaster, etc.
 4. Safety and disconnect switches and motor starters to be vacuum cleaned of debris and dust, and all surfaces free of stray paint, grease, and fingerprints.
 5. Switchgear, transformers, and system devices shall be cleaned internally and externally and have all surfaces restored to original surface conditions.
 6. Touch-up all scratched surfaces using paint matching the existing equipment paint. Where paint cannot be matched, the entire surface shall be repainted in a color and manner approved by the Engineer.

END OF SECTION

SECTION 26 0050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 1. Raceways.
 2. Building wire and connectors.
 3. Supporting devices for electrical components.
 4. Cutting and patching for electrical construction.
 5. Touchup painting.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Submittals not required.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devised, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow:
 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 RACEWAYS

- A. See Section "Raceways and Boxes."

2.2 CONDUCTORS

- A. See Section "Conductors and Cables."

2.3 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
 2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
- E. Raceways and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.

2.4 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transforming Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Provide power utility company communication conduit to meter.
- D. Relocate communication conduit with meter as required to maintain minimum utility company clearances.

2.5 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

- D. Right of Way: Give to raceways and piping systems installed at a required slope.
- E. Mount all non-wall mounted equipment minimum of:
 1. Two (2) inches off the wall for switchboards, free standing distribution boards, disconnects, panels and all other non-vibrating equipment.
 2. Minimum of four (4) inches for vibrating equipment to include transformers.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components. Supports for electrical raceways, boxes, equipment, fire alarm / public address / data / special system(s) / other low-voltage enclosures, and other entities encompassing wiring or devices of any voltage shall be connected to a recognized structural element.
[Note: For purposes of MEP work, ceiling grid shall **NOT** be considered a structural element unless prior written approval is given by Engineer on a case-by-cases basis.]
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install $\frac{1}{4}$ -inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for $1\frac{1}{2}$ inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used for alignment, 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. Support the box and raceway from structural supports.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Where exterior electrical equipment is mounted on unistrut racks and the top of the mounted equipment is taller than 60" above the mounting surface, provide rear triangular support for unistrut rack angled 30 degrees connected 2/3 way up the rack and mounted to the same structure as the unistrut rack. If mounting on a roof assembly support for the rear support shall go through the roof at 90 degrees.

- M. Install sleeves for cable and raceway penetrations of concrete slabs and walls. 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.
 - 1. Exception: Sleeves are not required for core-drilled penetrations where the hole is the same size as the outer conduit dimension. Tape or wrap conduit in contact with the concrete and firecaulk as required to maintain fire rating.
- N. Provide x-ray scans for all penetrations through concrete floors that are post tension.
- O. 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. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 7. Light Steel: Sheet-metal screws.
 - 8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Cutting and patching for electrical construction.
 - 6. Touchup painting.

3.8 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 0519
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field Quality-Control Test Reports: From Contractor.

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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, all conductors shall be listed for the application, temperature, and insulation rating to which they are intended.

2.2 CONDUCTORS AND CABLES

- A. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- B. Conductor Material:
 1. Copper complying with NEMA WC-70.
 2. Solid conductors, sizes 10 and 12, uncoated copper per ASTM B3.
 3. Stranded conductor, all other sizes, uncoated copper per ASTM B3, ASTM B787, and ASTM B8.
- C. Conductor Insulation Types: Type THHN-THWN and complying with NEMA WC-70.
 1. Rated for sunlight resistance all colors.
 2. Conductors shall be color coded for voltage and phase as per NEC and any local amendments.
 3. Larger conductors shall have taped color coding.
 4. Size, rating, temperature, and type shall be permanently marked on conductor jacket.
 5. Insulation shall be PVC, heat and moisture resistant, flame retardant compound as per UL-83 and UL-1063.
 6. Jacket shall be polyamide outer nylon covering per UL-83 and UL-1063.
- D. Rated for sunlight resistance all colors.

2.3 CONNECTORS

- A. Wire Connectors Size 6-14 AWG:
 1. Description: Factory-fabricated UL listed connected and of size, ampacity rating, material, type, and class for application and service indicated.
 2. Provide self-locking square wire spring grab screw on wire connectors sized as per NEC and the number of conductors to be connected.

3. Thermoplastic deep shell design, with wings on smaller connectors, rated for application temperature, Minimum 105 degrees C.
 4. Copper to copper connection, 600V.
 5. Provide high temp wire connectors for all high temperature equipment applications.
- B. Push-in wire connectors are **Not Approved** and shall not be used for any power or lighting circuits above 50V.

2.4 ALTERNATES

- A. Blue Jacketed steel MC Cable as allowed by code.
- B. AC cable is **not** permitted at all.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, suitable for use in air return plenums.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- E. Underground Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Minimum line voltage conductor size is #12.
- C. Neutrals shall not be shared on any single pole circuit.
- D. 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.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Install without damaging conductors/cable, shield, or jacket.
 1. Do not bend conductors/cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.
 2. All new installation cabling shall be one piece without breaks or splices except at device connections.
- G. Pull conductors/cables without exceeding manufacturer's recommended pulling tensions.
 1. Pull simultaneously if more than one is being installed in same raceway.
 2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.
- H. Provide pull boxes as per NEC.
- I. Provide junction or pull boxes at all splice points.
- J. Support cables according to Section "Basic Electrical Materials and Methods."
- K. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
- L. Identify and color-code conductors and cables according to Section "Electrical Identification" and adhere to local color code requirements.

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- C. 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. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- 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 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Erico Inc.; Electrical Products Group.
 - g. Framatome Connectors/Burndy Electrical.
 - h. Galvan Industries, Inc.
 - i. Harger Lightning Protection, Inc.
 - j. Hastings Fiber Glass Products, Inc.
 - k. Heary Brothers Lightning Protection, Co.
 - l. Ideal Industries, Inc.
 - m. ILSCO.
 - n. Kearney/Cooper Power Systems.

- o. Korns: C.C. Korns Co.; Division of Robroy Industries.
- p. Lightning Master Corp.
- q. Lyncole XIT Grounding.
- r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
- s. Raco, Inc.; Division of Hubbell.
- t. Robbins Lightning, Inc.
- u. Salisbury: W.H. Salisbury & Co.
- v. Superior Grounding Systems, Inc.
- w. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, $\frac{1}{4}$ inch 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_inches wide and 1/16 inches thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1_inches wide and 1/16 inches thick.
- H. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 - 1. No. 4 AWG minimum, soft-drawn copper conductor.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
- B. Ground Rods: Sectional type; copper-clad steel.
 - 1. Size: $\frac{3}{4}$ by 120 inches.
- C. Test Wells: Provide handholes for test wells.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel, ground rods, and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. 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.
- E. 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.
- F. 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 $\frac{1}{4}$ -x2x12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. 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 COUNTERPOISE

- A. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18 inches below grade and 24 inches from building foundation.

3.4 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 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.

3.5 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by

- connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 0533
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 1. Division 7 Section "Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 2. Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
 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. RNC: Rigid nonmetallic conduit.
- H. PVC-GRS: PVC-Coated galvanized rigid steel.

1.4 SUBMITTALS

- A. Submittals not required.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Refer to 3.1, RACEWAY APPLICATION, for materials to be used.

2.2 METAL CONDUIT AND TUBING

- A. Available Manufacturers:

1. AFC Cable Systems, Inc.
 2. Alflex, Inc.
 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 4. Electri-Flex Co.
 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 6. Republic Conduit.
 7. Manhattan/CDT/Cole-Flex.
 8. O-Z Gedney; Unit of General Signal.
 9. Wheatland Tube Co.
 10. Perma-Cote
 11. Plasti Bond
 12. KorKap
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC--Coated Steel Conduit and Fittings: UL514b NEMA RN 1.
- E. PVC- Coated IMC and Fittings: ETL PVC-001 NEMA RN 1 UL6.
- F. EMT: ANSI C80.3.
- G. FMC: Zinc-coated steel. Non UL listed FMC is not allowed for any line voltage (greater than 70V) system.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings: NEMA FB 1; compatible with conduit and tubing materials. Provide fittings factory matched with conduit types.
 1. Indoor Fittings: Steel Set Screw or Steel Compression
 2. Outdoor Fittings: Threaded fittings on IMC or Rigid Conduit
 3. Outdoor Fittings: Compression fittings with gaskets on all transitions to flexible conduit.
 4. Die cast fittings are not acceptable anywhere.
 5. Provide factory fittings with MC cable where allowed.
 6. EMT crimp type fittings are not acceptable.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers:
 1. American International.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Amco Corp.
 4. Cantex, Inc.
 5. Certainteed Corp.; Pipe & Plastics Group.
 6. Condux International.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; Division of Hubbell, Inc.
 12. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- D. LFNC: UL 1660.
- E. Fittings: NEMA TC 3; match to conduit or tubing type and material. Provide fittings factory matched with conduit types.
 1. Indoor/Outdoor Fittings: Compression.

2. Outdoor Fittings: Compression fittings with gaskets on all transitions to flexible conduit.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. Emerson/General Signal; Appleton Electric Company.
 - 3. Erickson Electrical Equipment Co.
 - 4. Hoffman.
 - 5. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - 6. O-Z Gedney; Unit of General Signal.
 - 7. RACO; Division of Hubbell, Inc.
 - 8. Stahlin
 - 9. Scott Fetzer Co.; Adalet-PLM Division.
 - 10. Spring City Electrical Manufacturing Co.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. 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.
- H. 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.

2.5 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors:
 - 1. Exposed: Rigid steel or IMC.
 - 2. Concealed: Rigid steel or IMC.
 - 3. Underground Secondary, Single Run: PVC Schedule 40 with long radius elbows.
 - 4. Underground Secondary, Grouped: PVC Schedule 40 with long radius elbows.
 - 5. Underground Primary: PVC Schedule 80 with long radius elbows.
 - 6. Primary Risers: PVC Schedule 80. With long radius elbows.
 - 7. Underground Data: PVC Schedule 40 with long radius elbows.
 - 8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
 - 9. Boxes and Enclosures: NEMA 250, Type 3R.

10. Under Canopies: IMC with sealed fittings.
 11. Penetrations through exterior walls: RMC or IMC
 12. Embedded in Concrete: Only in Approved locations – wrapped RMC or IMC.
 13. Coastal or Corrosive Locations or where specifically indicated on drawings: ETL PVC-001 PVC-GRS
- B. Indoors:
1. Exposed in Mechanical/Electrical/Unfinished Spaces: EMT.
 2. Exposed in Finished Spaces: Metal Surface Raceway painted/finished to match space finishes.
 3. Concealed: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFNC in damp or wet locations or with water equipment.
 5. Damp or Wet Locations: Sealed EMT with sealed fittings.
 6. Underfloor: Sealed EMT with sealed fittings or IMC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.
- C. Minimum Raceway Size: 1/2-inch for single 20A or less circuits; otherwise, 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating using the manufacturer's PVC touch up compound after installing conduits.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz.
- F. Aluminum conduit will not be accepted on this project.

3.2 INSTALLATION

- A. Conduit Routing:
1. All branch circuit conduit shall be run overhead unless specifically directed by the engineer.
 - a. Exceptions:
 - 1) Conduit to floor boxes.
 - 2) Conduit to locations otherwise inaccessible overhead (exposed or not).
 - 3) Conduit to exterior slab locations without overhead cover.
 - 4) Conduit to column mounted lighting, devices, or equipment inaccessible from above.
 2. Panel feeder conduits may be run in the floor or underfloor ONLY IF indicated on the drawings or directed by the engineer.
 3. Service secondary conduits may be run underfloor or in-ground.
 4. Conduit for exterior equipment or lighting may be run underfloor or in-ground.
 5. All conduit serving any equipment or devices (to include panels, transformers, and switchboards, or any other electrical distribution equipment) within the perimeter of the building shall be run within the perimeter of the building. Conduit shall not run across courtyards or underground from one section of the building to another section of the contiguous building.
 - a. Exception: Service entrance conduit.
 6. All conduit shall be run at right angles or parallel to the building lines to the limits that the structure will allow. Raceways shall not be run diagonal or curved.

- B. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Install raceways as high as possible and coordinate installation with other equipment.
- E. Install raceways to equipment mounted on the floor away from walls from overhead down to the equipment or disconnects. Do not run across the floor creating a tripping hazard. Rack support conduit at the disconnect.
- F. Provide clear access to all pull and j-boxes. Provide access doors over hard (non-lay-in ceilings) to all pull boxes. Minimum access required 1.5x (times) box cover size or 18 inches.
- G. Label all j-box and pull box covers with circuits contained within box.
- H. Under no circumstances shall power and data or any signal below 50V be shared in the same raceway, tray, channel, or sleeve.
- I. Install raceways for power conductors (any conductor over 50V) 12 inches from any signal/communications conductor (data, fiber optics, telephone, fire alarm, PA, community antenna and radio distribution (CATV), low power or network powered broadband communications, systems controls, and any other system operating under 50V) not in conduit on J-hooks.
- J. Install raceways for power conductors (any conductor over 50V) 12 inches from communications raceways. Communications raceways include; data, fiber optics, telephone, fire alarm, PA, community antenna and radio distribution (CATV), low power or network powered broadband communications, systems controls, and any other system operating under 50V.
 - 1. Exception: Data and power raceways shall be permitted to be 2 inches apart only at the wall drop to the devices. Above the ceiling or overhead the minimum 12 inch spacing shall be maintained.
 - 2. Exception: Listed dual channel power poles
 - 3. Exception: Within the surface raceways. When not within the surface raceway, the power and communications raceways shall be 12 inches apart.
 - 4. Underground: Data and power conduit/raceway shall be allowed in the same trench only if specifically allowed by the engineer and then there shall be a minimum of 12 inches of fill between the power and communications raceways. Magnetic marking tape shall be placed above the level of the highest (closest to grade) raceway.
- K. Exterior Exposed Raceways:
 - 1. See application schedule for raceway types.
 - 2. Provide non-flexible raceways through roofs to disconnects, panels, or receptacles as per application schedule.
 - 3. Provide transitions from non-flexible raceways to flexible raceways within 3 feet of the equipment.
 - a. Exception: Flexible raceways may exceed 3 feet only to accommodate the drip legs.
 - 4. Penetrate roofing membranes with approved methods only for the type of roof used. See roofing or architectural details.
 - 5. Provide chem-curbs on built-up roofs unless otherwise directed from roofing or architectural details.
 - 6. Support all exposed raceway on roofs with manufactured neoprene blocks with integral galvanized channel, conduit hangers as part of a manufactured assembly with galvanized channel (portable pipe hangers or equal), or approved method as per architectural.
 - 7. Exposed raceways on roofs shall not be unsupported in any areas nor attached directly to the roof.

8. Provide roof hoods for multiple conduits through roofs as indicated.
 9. Provide drip legs for all exterior exposed raceways from disconnects to equipment.
- L. Buried Raceways:
1. See application schedule for raceway types.
 2. Label all buried conduits.
 3. Provide spacers between all buried conduits for a neat and uniform installation. Conduit shall not be "stacked" on top of each other without manufactured spacers.
 4. IF telecommunications conduits and power conduits (only under 600V) are allowed in the same trench by owner or engineer, provide a minimum of 12 inches of compacted earth between the conduit racks. Provide magnetic marking tape between the communications conduits and the power conduits.
 5. Under NO circumstances shall power conduits over 600V be in the same trench as the communications conduits.
 6. All communications conduits shall have long radius elbows 10x the conduit diameter, but no less than 30", rising up into the building or communications equipment.
 7. Provide concrete encasement for all primary building feeders unless directed by utility company.
 8. Provide concrete encasement for all secondary building feeders unless otherwise noted.
 9. Provide pull strings/tape (per size and distance) for all empty conduits.
 10. Minimum depth of primary or medium voltage conduits 42 inches. (600V and above).
 11. Minimum depth of secondary or low voltage conduits 30 inches. (0 to 600V).
 12. All 90 degree changes in direction shall be long radius.
 13. Provide metal backed marking tape at 12 inches below grade and 6 inches above all buried raceways.
 14. Clean and swab out all conduits prior to installing conductors.
 15. Any metallic conduit coming in contact with earth, insulate with approved tape or asphalt paint.
- M. All underfloor conduits shall be supported as per NEC.
1. See application schedule for conduit types.
 2. All conduit supports shall be anchored to structure.
 3. Provide support for multiple conduits with galvanized kindorf rack, conduit straps, all thread rod to angles, and mount angles to structure.
 4. ONLY IF specifically directed by owner or engineer to use RNC underfloor:
 - a. Provide support for 2" and below conduit every 48 inches.
 - b. Provide support for 2-1/2" and above every 60 inches.
- N. Complete raceway installation before starting conductor installation.
- O. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- P. Install temporary closures to prevent foreign matter from entering raceways during construction. Remove prior to completion of conduit.
- Q. Sleeves: Provide metallic raceway sleeves through walls or floors for all conductors/cabling not in raceways. Provide bushings at both ends of sleeves prior to installing any conductors or wiring. Firestop as per opening fire rating requirements.
- R. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- S. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- T. Firestop: Firestop all raceway penetrations in rated walls. Provide intumescent fill in all sleeve openings. Contractor shall be responsible for all wall repair and damage. Excessive firestop for holes too large (1/2 inch beyond the edge of the raceway) is unacceptable. Holes shall be repaired with suitable wall materials to maintain the integrity of the wall construction.

- U. Cut openings in walls as per the outer edges of the raceway. Openings made with hammers or other wall damaging tools are not acceptable. Holes too large ($\frac{1}{2}$ inch beyond the edge of the raceway) are unacceptable and shall be repaired with suitable wall materials to maintain the integrity of the wall construction. Contractor shall be responsible for repair to match existing.
- V. Provide manufactured elbows of conduit type specified for PVC raceways. Field constructed elbows are not allowed. Rigid Non-metallic tubing shall not have any field fabricated 90 degree bends. Provide manufactured elbows at all 90 degree changes in direction.
- W. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- X. Raceways Embedded in Slabs are allowed ONLY where specifically called out or ALLOWED by structural and electrical engineer: Install in middle one-third of slab thickness where practical and leave at least 2 inches of concrete cover on the top and bottom.
 - 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 raceways parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
- Y. Expansion Joints: Provide flexible connections suitable for use with conduit type for all conduit in structural expansion joints or independent slabs that are within another structural assembly.
- Z. Raceways Through Slabs to Interior Spaces: Install where practical and leave at least 2 inches from any walls unless required to come up in the wall. Coordinate with grade or perimeter beams prior to installation.
 - 1. Secure raceways to concrete with conduit clamps.
 - 2. Change from nonmetallic raceways to rigid steel conduit or IMC before rising above the floor.
 - a. Exception: Raceways from below grade into transformers and switchgear enclosures shall be RNC with bushings.
 - b. Exception: Raceways from below grade for telephone boards and data/signal equipment shall be RNC with bushings.
 - 3. Tape conduit from minimum 3 inches below transition to 3 inches above the floor so that no portion of the rigid steel conduit or IMC is in contact with the concrete.
- AA. Install ALL exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
 - 3. Install conduit as high as possible.
 - 4. Flexible cable or raceway for general circuiting is allowed exposed in mechanical or electrical spaces only. Not allowed in finished spaces.
 - a. Exception: As equipment connection only.
- BB. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- CC. Tighten set screws of threadless fittings with suitable tools.
- DD. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.

2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- EE. Install pull tape/wires in empty raceways.
 1. For raceways under 2 inches and under less than 100 feet, use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
 2. Raceways under 2 inches and over 100 feet without intermediate pull boxes, provide mule tape. With intermediate pull boxes use pull wire.
 3. For raceways over 2 inches and use mule tape.
 4. Sleeves under 36 inches do not require pull tape/wire.
- FF. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways 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.
- GG. Install raceway sealing 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. Label boxes "seal-off". Install raceway sealing fittings at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- HH. 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 finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- II. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures if not using MC Cable for lighting whips; for equipment subject to vibration, noise transmission, or movement, and for all motors indoors of non-water operating equipment. Use LFNC in damp or wet locations or to any water operating equipment. Install separate ground conductor across flexible connections.
- JJ. Prime and Paint exposed conduit in finished spaces, unless pre-painted surface raceways is provided, as per owner/architect. Provide with paintable surface.
- KK. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- LL. Floor Boxes:
 1. Set floor boxes level. Grout around floor box to fill in area around box opening.
 2. Trim after installation to fit flush with finished floor surface.
 3. Ground floor box with circuit grounding conductor.
 4. Coordinate covers with floor finishes. Provide covers with inserts for tile or carpet.
 5. Floor boxes shall be flush with finish floor.
- MM. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- NN. Cap all un-used/spare conduits. Does not include sleeves.
- OO. Wireways or gutters above panelboards, switchboards, distribution boards, or any other circuit distributing panel shall not be wider than 1.5x (times) the width of the panel or panels if adjoining.

PP. Under no circumstances shall wireways, pull boxes, or gutters wrap the room and be used as a channel for circuits, unless specifically called out by the engineer or per manufacturers shop drawings.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
 - 3. Provide cover over conduits during storage to prevent dirt and debris from entering conduits during storage.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.
- B. Remove debris from conduits prior to capping any spare conduits.
- C. Blow-out empty conduits that are future spares in any exterior or underground installation prior to capping.

3.5 RECORD

- A. Record the location of all spare conduits buried for future use by the owner.

END OF SECTION

SECTION 26 0553
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAYS AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- D. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.2 NAMEPLATES AND SIGNS

- A. Safety signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
 - 1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 - 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
 - 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
 - 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Install painted identification according to manufacturer's written instructions and as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime surfaces using type of primer specified for surface.
 - 3. Apply one intermediate and one finish coat of enamel.
- F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- G. Circuit Identification Labels on Boxes: Install labels externally.
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 - 2. Concealed Boxes: Plasticized card-stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
 - 4. Normal Power Circuits: Black lettering and numbers
- H. Color-Coding of Secondary Branch Circuit Conductors: Use the following colors for service, feeder, and branch-circuit branch circuit conductors:
 - 1. 120/240V Single Phase Conductors:
 - a. Phase A: Black.
 - b. Phase B: Red or Blue.
 - c. Neutral: White.
 - d. Ground: Green.
 - 2. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-

- wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
- b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- I. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
1. Legend: $\frac{1}{4}$ -inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
- J. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- K. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install 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.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum $\frac{3}{8}$ -inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- L. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with $\frac{1}{2}$ -inch- high lettering on $1\frac{1}{2}$ -inch-high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
 2. Access doors and panels for concealed electrical items.
 3. Disconnect switches.
 4. Enclosed circuit breakers.

END OF SECTION

SECTION 26 0800
ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 26 responsibilities in the commissioning process which are being directed by the CxA. Other electrical systems testing may be required by other specification sections and under the direction of the CM.
- B. The list of commissioned equipment and systems is found in Section 01 9100.1.3.C.
- C. Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 9100. Division 26 shall be familiar with all parts of Section 01 9100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- D. Related Sections
 - 1. Section "Submittal Procedures"
 - 2. Section "Project Closeout"
 - 3. Section "Warranties and Guarantees"
 - 4. Section "Interior Lighting"
 - 5. Section "Exterior Lighting"

1.2 RESPONSIBILITIES

- A. Electrical Contractors. The commissioning responsibilities applicable to the electrical contractor are as follows (all references apply to commissioned equipment only):
Construction and Acceptance Phases
 - 1. Include the commissioning cost of the electrical contractor in the contract price.
 - 2. In each purchase order or subcontract written, include requirements for submittal data, O&M data, and training.
 - 3. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
 - 4. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.
 - 5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
 - a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipments and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
 - 6. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.
 - 7. Provide limited assistance to the CxA in preparing a full start-up and initial checkout plan using manufacturer's start-up procedures. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CxA for review. Refer to Section 019100 for further details on start-up plan preparation.
 - 8. Perform all completed start-up and system operational checkout procedures in the presence of the CxA.
 - 9. Address current A/E punch list items before functional testing.

10. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.
11. Perform functional performance testing under the direction of the CxA for specified equipment in Section 019100. Assist the CxA in interpreting the monitoring data, as necessary.
12. Correct deficiencies (difference between specified and observed performance) as interpreted by the CxA, CM and A/E and retest the equipment.
13. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
14. During construction, maintain as-built red-line drawings for all drawings and final CxAD as-builds for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builds for contractor-generated coordination drawings.
15. Provide training of the Owner's operating personnel as specified.
16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Correct deficiencies and make necessary adjustments to O&M manual and as-built drawings for applicable issues identified in any seasonal testing.

1.3 RELATED WORK

- A. Refer to Section 01 9100, Part 1.1 for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 01 9100 Part 1.3 C for systems to be commissioned.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Division 26 shall provide submittal documentation relative to commissioning as required in this Section Part 1 and Section 01 9100.

3.2 STARTUP

- A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 9100. Division 26 has start-up responsibility and is required 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 commissioning agent or Owner.
- B. Functional testing is intended to begin after completion of the Field Installation Verifications and Operational Performance Tests. Functional testing shall not proceed prior to the completion of systems or sub-systems.

3.3 FUNCTIONAL PERFORMANCE TESTS

- A. Refer to Section 01 9100 Part 1.3 for a list of systems to be commissioned and to Part 1.5 for a description of the process.

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 01 9100 Part 3.7 for specific details on non-conformance issues relating to pre-functional checklists and tests.

3.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the GC for inclusion in the O&M manuals, according to this section and Division 1 Section "O&M Documentation," prior to the training of owner personnel.
- B. The CxA shall receive a copy of the O&M manuals for review.
- C. Review and Approvals. Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CxA. Refer to Division 1 Section "O&M Documentation" for details.

3.6 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 019100 for additional details.
- B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019100 for additional details.
- C. Electrical Contractor. The electrical contractor shall have the following training responsibilities:
 1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 0 19100, Part 3.9.
 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including start-up, shutdown, fire/smoke alarm, power failure, etc.
 4. 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.
 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment.
 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. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
 8. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 9. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.

3.7 DEFERRED TESTING

- A. Refer to Section 01 9100, Part 3.6 for requirements of deferred testing.

3.8 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 01 9100.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Time switches.
 2. Photoelectric switches.
 3. Indoor occupancy sensors.
- B. Related Requirements:
1. Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Contractor to submit entire lighting control system shop drawings showing locations of devices, coverage areas delineated with contour style lines, power pack or controller locations, connections, photocells and locations, and control wiring required.
1. Show installation details for occupancy and light-level sensors.
 2. Interconnection diagrams showing field-installed wiring.
 3. Include diagrams for power, signal, and control wiring.
 4. Sensors shall overlap in coverage areas requiring multiple sensors.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Invensys Controls.
 4. Leviton Manufacturing Co., Inc.
 5. NSi Industries, LLC: TORK Products
 6. Lithonia
- B. Electronic Time Switches: Solid state, 7-day programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: SPST.
 3. Contact Rating: 30-A inductive or resistive.
 4. Programs: See drawings for number of channels, minimum one channel per circuit plus one spare; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work includes, but are not limited to, the following:
 1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries, LLC; TORK Products.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 CEILING MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
 5. Lutron Electronics Co., Inc.
 6. NSi Industries LLC; TORK Products.
 7. Sensor Switch, Inc.
 8. Square D.
 9. Watt Stopper.
- B. General Requirements for Sensors: Ceiling-mounted, 360 degree, solid-state indoor occupancy sensors with a separate power pack.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Turn lights on or enable wall manual switch when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 20 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Internal dry contact closure for SPDT.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
 9. Dimming output to control 0-10 VDC.
 10. Provides second occupancy time out period enabling lighting to go dim prior to off.
 11. Adjustable maximum minimum.
 12. Can be series or parallel connected.
 13. Photo Cell:
 - a. Auto set point
 - b. On/Off mode during occupancy
 - c. Dimming control
- C. Standard Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 15 ft. radius when mounted on a 108-inch high ceiling.
- D. Extended Range Dual-Technology Type: Ceiling Mounted
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 28 ft. radius when mounted on a 108-inch high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Bryant Electric.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Manufacturing Co., Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Brands Lighting, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.
 10. Sensor Switch, Inc.
 11. Square D.
 12. Watt Stopper.

- C. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- D. Wall-Switch Sensor:
 - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft (196 sq. m).
 - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 - 3. Switch Type: SP. SP, field selectable automatic "on," or manual "on" automatic "off."
 - 4. Voltage: Dual voltage, 120 and 277 V.
 - 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 - 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - 9. Programmable for occupancy or vacancy mode.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section "Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Plenum rated, multiconductor cable with stranded-copper conductors.
- C. Class 1 Control Cable: Plenum rated, multiconductor cable with stranded-copper conductors.
- D. All exterior or underground cabling shall be rated for location.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Coordinate location of wall mounted devices with millwork and other wall mounted devices to optimize sensor field of view. Do NOT mount sensors directly behind doors.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- D. Provide factory representative to locate and calibrate daylight sensors (both stand-alone and integral to fixture) for daylight harvesting (dimming). Verify operation and document settings.
- E. Contractor to verify all sensors intended operation and calibrate sensor field of view and sensitivity. Adjust to capture major movement through space openings.
- F. Coordinate with owner for occupancy/vacancy sensor delay times.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.
- B. Mount cabinet to wall or unistrut frame.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section "Control/Signal Transmission Media." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Support ceiling mounted backboxes from structural elements or supports that are directly attached to structure. Do not support directly from ceiling grid.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to "Electrical Identification."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections on ALL the sensors with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Verify emergency lighting automatic switchover to generator power at all UL 924 rated light fixture locations.
 - 4. Verification of sensor operation
 - a. Sensor turns lighting on/off at programmed times
 - b. Sensor automatically dims lighting
 - c. Sensor enables additional switching
 - d. Sensor works during emergency lighting generator operation with automatic changeover
 - e. Sensors coverage meets operational intent. Rotate ceiling sensors or adjust wall mounted sensor windows to maximize coverage.
- C. Lighting control devices will be considered defective and replaced with new if they do not pass tests and inspections.
- D. Prepare a written report to be sent to the engineer for review indicating the following:
 - 1. Room Number
 - 2. Sensor Type (wall, ceiling, occupancy vacancy, daylighting)
 - 3. Delay time
 - 4. Operation Verification (Yes/No)

3.6 DEMONSTRATION

- A. Coordinate demonstration of products with Owner prior to substantial completion.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 1310
PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances necessary for the execution, installation and completion of all work specified herein.
- B. Pull and junction boxes of appropriate size and depth as specified hereinafter.

1.2 SUBMITTALS

- A. Submittals for products furnished under this section are not required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. For interior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, $\frac{3}{4}$ -inch flanges, screw covers, etc.
- B. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, $\frac{3}{4}$ -inch flanges, bolted covers with full gaskets forming a completely raintight assembly for above ground installations. Provide concrete boxes with screw fittings and drains for in ground pull boxes. Boxes shall be sized as per NEC.
- C. See drawings for pull boxes requiring racks.
- D. Boxes with concentric knockouts are not acceptable.
- E. Provide ground terminal strip and ground pull box and circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide junction boxes as shown on drawings and otherwise where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4 inches square and $2\frac{1}{8}$ inches deep. Provide screw covers for junction boxes.
- B. Use minimum 16-gauge steel for pull boxes and provide with screw cover.
- C. Install boxes in conduit runs wherever necessary to avoid too long runs or too many bends. Do not exceed 100-foot runs without pull boxes.
- D. Rigidly secure boxes to walls or ceilings. Conduit runs will not be considered adequate support.
- E. Install boxes with covers in accessible locations.
- F. Pull boxes, wireways or gutters above panelboards, switchboards, distribution boards, or any other circuit distributing panel shall not be wider than 1.5x (times) the width of the panel or panels if adjoining.
Under no circumstances shall wireways, pull boxes, or gutters wrap the room and be used as a channel for circuits, unless specifically called out by the engineer or per manufacturers shop drawings.
- G. Observe maximum conductor fill as required by the National Electrical Code.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes load centers and panel boards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 1. Lighting and appliance branch-circuit panel boards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter (GFI).
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panel board, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Field Tests 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.
- D. Panel board Schedules: For installation in panel boards. Submit final versions after load balancing.
- E. Maintenance Data: For panel boards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," 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. Testing Agency Qualifications: Testing agency that is a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- 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. Coordinate layout and installation of panel boards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

- A. Keys: Six (6) spares of each type of panel board cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:
 - 1. Panel boards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Siemens
 - b. Square D Co.
 - c. Eaton
 - d. GE/ABB

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity. Aluminum is **NOT** acceptable.
- G. Main and Neutral Lugs:
 - 1. Compression type suitable for use with conductor material on MLO panels.
 - 2. Mechanical type suitable for use with conductor material on MCB panels.

- H. Equipment Ground Bus: Copper, Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Service Equipment Label: UL labeled for use as service equipment for panel boards with main service disconnect switches.
- J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- K. Gutter Barrier: Arrange to isolate individual panel sections.
- L. Feed-through Lugs: Compression type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANEL BOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- C. See panel schedules for minimum rating.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANEL BOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. Breakers shall be fully rated for panel AIC rating.
 - 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. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Compression 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panel boards and accessories according to NEMA PB 1.1 and the NEC.
- B. Provide minimum clearance in front of panelboards: 36 inches clearance in front of 120/208V and 42 inches in front of 277/480V panel boards.
- C. Space panels 4 inches apart and provide spacing for future panels.
- D. Locate Surge suppression above and adjacent to panelboard serving. Provide additional spacing between panelboards. Surge suppression to be no greater than 7 feet above finished floor.
- E. Locate contactors adjacent to panelboards and provide additional spacing. Small contactor enclosures can be above and to the right or left of the panelboard. Contactor mounting height to be no greater than 7 feet above finished floor.
- F. Coordinate with other equipment in the room.
- G. Coordinate location of panelboards with transformers and conduit feeders.

- H. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated. Mount with at least 6 inches of clearance below panel board.
- I. Mounting: Plumb and rigid without distortion of box. Mount recessed panel boards with fronts uniformly flush with wall finish.
- J. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panel board loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Use manufacturers supplied card and permanent slot location.
- K. Install filler plates in unused spaces.
- L. Provision for Future Circuits at Flush Panel boards: Stub four 1-inch empty conduits from panel board into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- M. Provision for Future Circuits at Recessed panel boards: Stub four $\frac{3}{4}$ " inch empty conduits from panel board into accessible ceiling space or space designated to be ceiling space in the future. Stub four $\frac{3}{4}$ " inch empty conduits into raised floor space or below slab not on grade.
- N. Wiring in Panel board Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.
- O. Wireways or gutters above panelboards, distribution boards, or any other circuit distributing panel shall not be wider than 1.5x (times) the width of the panel or panels if adjoining. Under no circumstances shall wireways, pull boxes, or gutters wrap the room and be used as a channel for circuits, unless specifically called out by the engineer or per manufacturers shop drawings.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Electrical Identification."
- B. Label and identify all breakers with permanent engraved labels for panel subfeeders and equipment connections on all distribution panelboards.
- C. Panel board Nameplates: Label all panel boards with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws. Provide red nameplates for emergency or stand-by power branch fed panels. Nameplate shall include:
 1. Normal Power
 - a. Panel Name
 - b. Voltage "120/240"
 - c. Panel fed from "panel name"

3.3 CONNECTIONS

- A. Install equipment grounding connections for panel boards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panel board bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- B. Testing: After installing panel boards 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. Balance 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 panel board, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panel boards. 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 2726
WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. GFCI/GFI: Ground-fault circuit interrupter.
- B. SPD: Surge protective device.

1.4 SUBMITTALS

- A. Product Data: For each product specified.

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.

PART 1- PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Wiring Devices:
 - a. Bryant Electric, Inc.
 - b. Eaton.
 - c. Hubbell, Inc.; Wiring Devices Div.
 - d. Killark Electric Manufacturing Co.
 - e. Leviton Manufacturing Co., Inc.
 - f. Pass & Seymour/Legrand; Wiring Devices Div.
 2. Multi-outlet Assemblies:
 - a. Airey-Thompson Co.
 - b. Wiremold.

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Commercial spec grade Configuration NEMA 5-20R. Color by Architect/Owner.
- B. GFCI 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 2½-inch-deep outlet box without an adapter. Provide with test light as per NEC.
- D. Fifteen-amp (15A) receptacles are not acceptable and shall not be installed unless specifically directed by the engineer.

2.3 SWITCHES

- A. Snap Switches: Commercial spec grade.

2.4 WALL PLATES

- A. Single and combination types match corresponding wiring devices. CSA certified and UL listed.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish. Color by Architect.
 - 2. Material for Finished Spaces:
 - a. Smooth, high impact self-extinguishing nylon, reinforcement ribs, captive screws; color by Architect/Owner.
 - 3. Material for Kitchens, Unfinished spaces (Mechanical, Electrical), and surface mounted locations: 302 brushed stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies straight, plumb and secure. Do not overtighten to deform faceplate. Adjust receptacle depth so faceplate mounts flush with wall. Adjust receptacle to extend equilaterally 1/8" beyond the faceplate opening.
- B. Install devices as per ADA height requirements.
- C. Review Architectural elevations to coordinate locations and mounting heights. If there are any discrepancies request information prior to install. If height is not listed on the drawings refer to the following:
 - 1. General purpose receptacles @ 18" AFF to the center of the duplex or simplex.
 - 2. General purpose receptacles at retirement facilities, nursing homes, hospice, nursing facilities @ 24" AFF.
 - 3. TV receptacles at the TV mounting location (see architectural elevations) or at 96" AFF.
 - 4. Above counter receptacles @ 6" above backsplash.
 - 5. Toilet room receptacles @ 48" AFF to the top of the box
 - 6. Switches to be 48" AFF to the centerline of the switch.
 - 7. Equipment receptacles at the piece of equipment. Coordinate with architectural elevations and equipment submittals.
 - 8. Refrigerator receptacles mount at 36" AFF to the center of the receptacle.
 - 9. Receptacles shall not be installed flat on any counter surface.
 - 10. No general purpose receptacles shall be below 15" in height or above 48" AFF.
- D. Install wall plates when painting is complete. Remove all paint from any wall plates.
- E. Provide GFI receptacles within 6 feet of all sinks, exterior receptacles, undercounter equipment, at exterior HVAC equipment, vending machines, and in kitchens.
- F. Install wall dimmers to achieve indicated rating after de-rating for ganging as instructed by manufacturer.
- G. Do not share neutral conductor on load side of dimmers.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multi-gang wall plates.
- I. Protect devices and assemblies during painting.
- J. Mount receptacles in millwork flush with the millwork. Provide extension rings.
- K. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
- L. GFCI or GFI receptacles shall be wired to "trip" individually not the entire circuit. Receptacles shall not be daisy chained together from a GFI and create a GFI "protected" receptacle.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 2816
DISCONNECT SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes individually mounted switches and circuit breakers used for the following:
 1. Service disconnect switches.
 2. Feeder and equipment disconnect switches.
 3. Motor disconnect switches.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 1. Section "Wiring Devices" for attachment plugs and receptacles, and snap switches used for disconnect switches.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for disconnect switches, circuit breakers, and accessories specified in this Section.
- C. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
- D. Field test reports.
- E. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

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:
 1. Molded-Case Circuit Breakers and Disconnect Switches
 - a. Siemens Energy & Automation, Inc.
 - b. Square D Co.
 - c. Eaton
 - d. GE/ABB

2.2 DISCONNECT SWITCHES

- A. General: Heavy Duty safety switch, service entrance rated if indicated, with grounding lug kit, rated for equipment amperage, capable to be locked in the open position, with number of poles matching equipment connections.
- B. Enclosed, 600V Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle. Switch shall be rated for equipment amperage.
- C. Enclosed, 600V Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position. Switch shall be rated for equipment amperage.
- D. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
- E. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed, Molded-Case Circuit Breaker: UL 489, with lockable handle. Bolt on mounting.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current. Breakers will be fully rated for circuit AIC rating.
- C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
- D. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- E. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
- F. Surge Protective Device: IEEE C62.41, to meet requirements for category indicated.
 - 1. Exposure: High.
 - 2. Impulse sparkover voltage coordinated with system circuit voltage.
 - 3. Factory mounted with UL-recognized mounting device.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions. Provide 2-inch clearance for operation and maintenance.
- B. Install disconnect switches and circuit breakers level and plumb. Height of handle centerline shall not exceed 68 inches. Provide required clearance in front of disconnect switches voltage requirements by NEC.
- C. Install disconnecting means (safety switch, enclosed circuit breaker, motor rated switch) for equipment independent of the equipment unless directly by engineer. In interior installations, mount on unistrut racks or suspend from structure. Exterior installations shall be mounted on galvanized unistrut racks. Provide working clearance in front of disconnecting means. Interior above ceiling disconnecting means shall be clearly visible from the equipment point of connection. Coordinate location with equipment.
- D. Install wiring between disconnect switches, circuit breakers, control, and indication devices.

- E. Provide power to all shunt trip circuit breakers/switches from panel the breakers are mounted in or fed from unless indicated otherwise on drawings. Provide 20A 1P CB and label shunt trip power.
- F. Grounding: Ground case and metallic conduit of disconnects.
- G. Provide working clearance in front of disconnect switch per NEC, minimum 36 inches.
- H. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486 A and UL 486 B.
- I. Label and identify each disconnect switch and enclosed circuit breaker according to requirements specified in Section "Electrical Identification." Labels shall be 1" for 100A and smaller, 2" for 200 – 400A switches, and 3 inch for larger switches.
- J. Label and identify each switch and breaker in MCC, distribution panels, and switchboards with 1" permanent engraved label indicating name and rating.
- K. Engage factory tech to set all adjustable breaker settings per actual equipment installed. Coordinate with manufacturer for required settings and engage qualified agency (testing company/manufacturer) to obtain breaker settings.

3.2 FIELD QUALITY CONTROL

- A. Testing: After installing disconnect switches and circuit breakers 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 stated in NETA ATS, Section 7.5 for disconnect switches 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 1. Dimensions of fixtures.
 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 4. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- D. Dimming Driver Compatibility Certificates: Signed by manufacturer of driver certifying that drivers are compatible with dimming systems and equipment with which they are used.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.
- G. Photometric Analysis: Submit point-by-point values on 1/8" = 1'-0" plans for all interior rooms. Calculations shall be made using (1) no masking, (2) light loss factor of 0.95, (3) point-by-point spacing of 24" x 24", and (4) reflectances of 80/50/20. In addition, also provide calculated average, maximum, and minimum footcandle values in a schedule for each room. Illuminance values (in footcandles) shall be for a calculation plane (workplane) at 30" AFF unless stated otherwise. Architectural plans in AutoCAD format shall be provided by Engineer for calculations upon request. Refer to architectural drawings for ceiling heights.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.
- D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Warranties for LED Drivers; Written warranty, executed by manufacturer agreeing to replace LED drivers that fail in materials or workmanship within five years from date of manufacture, but not less than four years from date of Substantial Completion.

PART 2- PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Models: All manufacturers (including those in the Lighting Fixture Schedule) are required to submit photometrics that illustrate the performance and light distribution as well as prove equal in quality to match those in the Lighting Fixture Schedule. Additional manufacturers beyond those in the Lighting Fixture Schedule may be considered as equal after review from the design engineer. For manufacturers not specified in the Lighting Fixture Schedule, submit photometrics to the design engineer for review prior to bid. Include a cross reference for each fixture submitted. Equipment submitted for "as-equal" without complete cutsheet cross reference, to include drawing fixture lettering, is subject to immediate rejection.
 - 1. Additional manufacturers will be considered on a case by case basis prior to bid. Post-bid non-approved manufacturers/models are subject to rejection and any cost difference for approved fixtures will be the contractors' responsibility.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components:
 - 1. Steel, unless otherwise indicated.
 - 2. Form and support to prevent warping and sagging.
 - 3. Housing painted after fabrication.
 - 4. Smooth hemmed sides and smooth inward formed end flanges.
- C. Doors, Frames, and Other Internal Access:
 - 1. 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.
 - 2. Standard extruded aluminum door frame has superior structural integrity with premium appearance and mitered corners. Door frame is painted after fabrication, standard. Powder-painted rotary cam latches provide easy, secure door closure. Integral T-bar clips are standard. Acrylic shielding materials is 100% UV stabilized.
- 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 minimum, unless greater thickness is indicated.
- F. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each ballast where indicated on drawings. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

G. Housings: Manufacturers standard with integral heat sink.

2.3 LED LIGHTING

- A. General: Comply with fixture component requirements.
- B. All LED products must be UL, ETL and/or CSA listed.
- C. All LED products must have LM-79 and LM-80 testing minimum and noted on specification sheet by an independent test lab and in accordance with the following:
 - 1. Lay-in Troffers: L90 at 60,000 hours at 25 degrees C.
 - 2. Surface Mounted: L80 at 60,000 hours at 25 degrees C.
 - 3. Pendant Mount: L90 at 60,000 hours at 25 degrees C.
 - 4. Recessed Can: L70 at 50,000 hours at 25 degrees C.
 - 5. Exterior Surf Mtd: L90 at 100,000 hours at 40 degrees C or
L80 at 100,000 hours at 25 degrees C *
 - 6. Exterior Fixtures shall be Thermally Protected Drivers
- D. All LED products should be identified as L70 and/or L90 ratings based on independent test lab data.
- E. Long-life LEDs, coupled with high-efficiency drivers, provide superior level and quality of illumination for extended service life.
- F. All outdoor and wet location listed products must clearly state the IP rating carried on the fixture based on independent test lab data.
- G. All LED products must be serviceable for accessible for field repair needs. Drivers and internal components are accessible from floor. LED boards include plug-in connectors for easy replacement or servicing. Suitable for direct insulation contact. Suitable for damp location.
- H. Standard embedded controls continuously monitor system performance, allow for constant lumen management/compensation function, facilitate simple "plug-and-play" network and controls upgrading via Cat-5 cable.
- I. Minimum CRI 80.
- J. All outdoor lighting color rendering should be within a 7 step McAdams Ellipse. All outdoor lighting should be 4100 Kelvin unless specifically noted.
- K. All indoor lighting color rendering should be within a 3 step McAdams ellipse. All indoor lighting should be 4000 Kelvin unless specifically noted.
- L. All LED drivers should be capable of 0-10 volt controls and DMX control and shall dim to 1% of total lumen output. Where specifically specified the dimming driver may be required to dim to .1% of lumen output, otherwise known as "dim to dark".
- M. Driver manufacturers must have a 5-year history producing dimmable electronic LED drivers for the North American market.
- N. Ambient driver temperatures must be within -20 degrees to 50 degrees C (-4 degrees to 122 degrees F).
- O. Driver must limit inrush current.
 - 1. Base specification: meet or exceed NEMA 410 driver inrush standard of 430 amp per 10 amps load with a maximum of 370 amps/2 seconds
 - 2. Preferred specification: Meet or exceed 30ma's at 277 VAC for up to 50 watts of load and 75A at 240us att 277 VAC for 100 watts of load
 - 3. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A
 - 4. No visible change in light output with a variation of plus/minus 10percent line voltage input.

5. Total harmonic distortion less than 20% and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD
- P. Any exceptions are at the engineer's discretion based on project needs and applicability.

2.4 EXIT SIGNS

- A. General Requirements: Comply with UL 924 and the following:
 1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
 2. Die cast brushed metal finish exit signage with manufacturer's multi-style mounting (wall, surface, and top). Plastic exit signage is not acceptable.
- B. Internally Lighted Signs: As follows:
 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
 2. All exit signs shall have battery back-up.
 3. Provide with self-diagnostics as indicated on the drawings.

2.5 FIXTURE SUPPORT COMPONENTS

- A. Comply with Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: ½-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, ½-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.6 FINISHES

- A. Fixtures: See fixture schedule for colors and finishes. Otherwise manufacturer's standard.
 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures, General: 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.
 1. Coordinate location of fixtures with architectural ceiling plan.
 2. Review architectural elevations prior to rough-in for any wall mounted fixtures. Mount at 84 inches or above, unless otherwise indicated. All wall mounted fixtures shall be ADA compatible if below 84 inches.
 3. Center single fixtures in rooms as much as possible.
 4. Center fixtures in exposed ceilings. Provide equal distance between fixtures and structural elements (walls, columns, furredowns, etc.).
 5. Provide switching mechanisms for all fixtures whether indicated on the drawings or not.
 6. Provide supports without causing deflection of ceiling or wall.
 7. Secure to outlet box.
- B. Track Lighting
 1. Install track parallel with structural or grid. Secure track to structural mounted j-boxes.
 2. Conceal transformers above accessible ceiling.
 3. Coordinate with architect for track lighting head locations.

4. Aim track heads at objects to be illuminated
 5. Adjust pendant track fixtures per architect/owner.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for alignment.
1. Install a minimum of four (4) ceiling support system rods or wires attached to the fixture structure on **EACH** fixture secured to the building structure. Locate not more than 6 inches 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 (2) $\frac{3}{4}$ -inch metal channels spanning and secured to ceiling tees.
- D. Suspended Fixture Support: As follows:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging. Provide blocking for heavy fixtures.
 2. Stem- Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 4. Coordinate mounting heights with Architect/Engineer. Consult prior to hanging. Stems may need to be field cut.
 5. Chain hung fixtures are NOT acceptable unless indicated on the drawings.
 6. Provide secondary support for all fixtures without canopy support from structure.
 - a. All high and low bay fixtures shall have secondary support cables secured to structure.
 7. Sized and rated for fixture weight.
 8. Do not use ceiling grid as support for pendant luminaires. Connect support wired or rods to building structure.
- E. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
 2. Do not attach luminaires directly to gypsum board.
 3. Provide blocking to support.

3.2 CONNECTIONS

- A. Ground equipment:
1. Tighten electrical connectors and terminals according to manufacturers' published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Connect to switch mechanisms (wall switch, contactors, relays) room controllers.
- C. Provide dual switching for room mounted dual switched fixtures. Wire each switch leg to each driver. Do not connect together unless directed by engineer.
- D. Provide unswitched same circuit hot conductor to all battery backup fixtures.
- E. Fixture Connections:
1. Indoors
 - a. With Lay-in ceilings: Provide EMT home runs to structure mounted J-boxes. Provide MC Cable from above ceiling j-boxes to fixtures. Do not daisy chain

- fixtures together unless specifically indicated on the drawings or allowed by engineer.
- b. With gypsum ceilings: Provide EMT home runs to structure mounted J-boxes. Provide access to j-boxes or locate above fixtures. Provide MC Cable from above ceiling j-boxes to fixtures. Do not wire daisy chain fixtures together, unless indicated on the drawings.
 - c. Exposed (no ceiling) in finished spaces: Conceal EMT as much as possible in adjacent walls. Route EMT to fixtures in exposed spaces with steel compression fittings and install parallel along structural members to structural mounted j-boxes. Conceal conduit along structural members. DO NOT route conduit across open spaces suspended from structural members unless directed by architect or engineer. Mount fixtures from j-boxes. Center fixtures in spaces.
 - d. Exposed unfinished spaces: Provide EMT runs to structural mounted j-boxes. Route parallel to structural members as much as possible. Mount fixtures or fixture support to j-boxes.
2. Outdoor: Provide IMC for exterior fixtures and connect directly to fixtures or j-boxes as required for fixture mounting. Exterior fixtures mounted in ceilings or structure can use EMT to fixture j-box mounts.

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 (Except LED Fixtures): Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Malfunctioning LED Fixtures: Replace fixture then retest. LED fixtures shall not be repaired.
- G. 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 31 3116 TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chemical soil treatment.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor barrier placement under concrete slab-on-grade.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2019.

1.04 SUBMITTALS

- A. See Section 01 3000 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 1. Having minimum of three (3) years documented experience.
 2. Approved by manufacturer of treatment materials.
 3. Licensed in Texas.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for requirements for application, and comply with EPA regulations.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of toxicants.

1.07 SEQUENCING

- A. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Manufacturers:
 1. Bayer Environmental Science Corp; ____: www.backedbbybayer.com/pest-management/#sle.
 2. Substitutions: See Section 01 6000 - PRODUCT REQUIREMENTS.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- D. Re-treat disturbed treated soil with same toxicant as original treatment.
- E. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION

**SECTION 32 1723
PAVEMENT MARKINGS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification describes the procedures and product for the marking (painting) of pavement. A handicapped sign is to be placed at each handicapped parking space. For van accessible spaces, a van accessible sign is required and is to be mounted on the same pole as the handicapped sign.

1.02 SUMMARY

- A. Section Includes Markings for:
 1. Parking Spaces.
 2. Crosshatched handicapped aisles.
 3. Crosshatched sidewalks.
 4. Handicapped parking spaces.
 5. Firelane.

1.03 SUBMITTALS

- A. Five copies of product data sheets shall be submitted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Pavement Marking Paint:
 1. White – Sherwin Williams Setfast Acrylic Waterborne Traffic Marking Paint product No. TM 2160 non-reflective, or approved equal.
 2. Red – Sherwin Williams Setfast Acrylic Waterborne Traffic Marking Paint product No. TM 2132 non-reflective, or approved equal.

PART 3 - EXECUTION

3.01 APPLICATION AND CONSTRUCTION

- A. All markings shall be applied and surfaces prepared as recommended by the product Manufacturer.
- B. Stripe width for parking spaces and similar type markings shall be a minimum of four (4) inches.
- C. Diagonal stripes at 45 degrees shall be painted on handicapped access aisles at handicapped parking spaces, crosswalks, and pedestrian loading zones. Perpendicular distance between diagonal stripes shall be thirty-six (36) inches center to center.
- D. Paint shall have net film thickness of 0.015 inches.
- E. Paint shall be applied no sooner than 14 days after seal coat has been applied.
- F. Paint shall be applied in one (1) coat.
- G. Paint shall be applied as shown on drawings.
- H. Glass spheres or reflectorized granules shall be applied before the paint sets or dries, evenly at a rate of six (6) pounds of glass spheres or 1.7 pounds of reflectorized granules per gallon of paint.

END OF SECTION