PROJECT MANUAL

NEW OFFICE BUILDING FOR:

KANSAS SECURED TITLE
34TH AND FAIRLAWN ROAD, TOPEKA, KS

PROJECT NUMBER: 171003
DATE: AUGUST 4, 2017
PROJECT MANUAL

August 4, 2017

PROJECT NUMBER: 171003

PROJECT
Kansas Secured Title
34th and Fairlawn Road
Topeka, Kansas 66614

OWNER
Kansas Secured Title

CONTRATOR
McPherson Contractors, Inc.
3501 SW Fairlawn Road, Suite 100
Topeka, KS  66614
Phone:   (785) 273-3880
FAX:     (785) 273-1037
Email:   mcmcperson@mcphersongc.com

ARCHITECT
Schwerdt Design Group, Inc.
2231 SW Wanamaker Rd., Suite 303
Topeka, KS   66614
Phone:   (785) 273-7540
Attn:    Michael K Hampton, AIA
Email:    mkh@sdgarch.com

CIVIL ENGINEER
CFS Engineers
2930 Woodside Drive
Topeka, KS   66614
Phone:   (785) 272-4706
Attn:    Kevin Holland, PE
Email:    kholland@cfse.com

STRUCTURAL ENGINEER
Certus AE Group
900 S. Kansas Ave., Suite 400
Topeka, KS   66612
Phone:   (785) 291-0400
Attn:    Aaron Scott, PE
Email:    aaron.scott@certusse.com

MECHANICAL/ELECTRICAL ENGINEER
Pearson Kent McKinley Raaf Engineers, LLC
2933 SW Woodside Drive, Suite C
Topeka, KS   66614
Phone:   (785) 273-2447
Attn:    Scott McKinley, PE
Email:    scott.mckinley@pkmreng.com

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<th>TITLE</th>
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</thead>
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<tr>
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<td>Table of Contents</td>
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Not Applicable

DIVISION 13 - SPECIAL CONSTRUCTION
Not Applicable

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Not Applicable

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Division I: General Requirements

1. Construction Schedule

(Reference Attached Sample Subcontract Agreement and Project Schedule)

2. Safety

Subcontractors shall comply with all applicable provisions of all federal and state government safety laws and codes and McPherson Contractors, Inc. Safety Manual. Subcontractor acknowledges the requirement for positive fall restraint and fall protection for all fall hazards over six feet. Subcontractor acknowledges the requirement for positive fall restraint for its personnel in aerial lifts.

A copy of your company Health and Safety Manual and site specific safety plan shall be on file and available for review at all times when working on site.

All Subcontractors will conduct their own safety meetings, make a record of the meetings, and provide copies to MCI.

Subcontractors will be required to re-install any safety railing and/or opening protection that are removed or damaged in connection with his own work.

Subcontractors shall immediately respond and correct any safety deficiency called to their attention. Repeat violations will not be tolerated and Subcontractor’s and/or their employees may be removed from site for repeated failure to comply with site safety requirements.

Subcontractor employees will be required to attend a weekly all jobsite safety meeting.

3. Insurance Requirements

(Reference Sample Insurance Certificate)

SUBCONTRACTOR shall purchase and maintain insurance with an insurance carrier(s) rated A- or better by AM Best. Second tier subcontractors (sub-subcontractors) must comply with the same requirements.

The following types and limits apply unless the Prime contract requires a greater level:

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<th>Each Occurrence</th>
<th>General Aggregate</th>
<th>Products/completed Ops aggregate</th>
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SUBCONTRACTOR is required to name the following as a primary non-contributory additional insured on policies, including products and completed operations:

- McPherson Contractors, Inc.
- McPherson Development, Inc.
- Project Owner
- Project Architect/Engineer

SUBCONTRACTOR agrees, to the fullest extent permitted by applicable law, to defend, indemnify, and hold harmless MCI and or any other indemnities named and as required by Section 9 of McPherson Contractors, Inc. Subcontract Agreement.

SUBCONTRACTOR is required to provide satisfactory evidence showing that policies do not contain exclusions or endorsements that limit liability insurance protection for subcontracted work or for any work performed under this agreement, such as residential construction, EIFS, or other trade practices applicable to the scope of work.

SUBCONTRACTOR shall furnish MCI with a current Certificate of Insurance on the standard Accord form with a provision for 30 day written notice to MCI prior to cancellation or material modification. Payments will not be made without a current and acceptable Certificate of Insurance.

In the event MCI obtains Builder’s Risk coverage, which does protect Subcontractor, Subcontractor agrees to pay all deductible amounts on claims made by Subcontractor against Builder’s Risk Policy providing coverage for Subcontractor on the project.

Additional Insured is required at no additional cost to MCI or Owner.

4. Progress Pay Estimates

For Lump Sum agreements, each applicant shall submit a schedule of values to the Contractor for approval prior to the first pay request. No payment applications will be processed without an approved schedule of values. For Cost-Plus-Fee agreements, payment will be based on actual cost for the month being billed (plus fee), including all supporting data as deemed necessary by MCI.

All monthly pay requests shall be submitted on a Progress Payment form AIA G702 and G703, should reflect all work completed through the 30th of the month and be received no later than the 20th of the month (or earlier if required by the Project). A properly completed Waiver and Lien Release must accompany each Application for Payment.

Subject to proof of storage in a bonded and insured warehouse and owner’s approval, MCI will consider payment for stored materials when stored off-site. Materials stored on-site will be paid as approved by the project owner or as allowed by the owner.

5. Changes to the Work

Change order requests must be itemized to identify material, labor and equipment quantities. Unless noted otherwise in the contract documents or owner/contractor agreement, the maximum allowable total markup is 12% for subcontractors and suppliers.
6. **Retainage**

Retainage will be withheld from each payment application on all subcontracts in accordance with the prime contract and/or current law. The retained amount will be 10% and will be withheld until paid or released by the project owner and/or when deemed acceptable to pay at MCI’s sole discretion.

7. **Lien Waivers**

All Subcontractors will execute the Receipt and Release form prior to receiving the final payment on the contract. If bonded, the bonding company must issue Consent of Surety to release final retainage.

8. **Field Communications**

Subcontractor is to have a supervisor on site at all time work is being performed by that contractor. This supervisor shall be fluent in the English language, capable of communications with his workers, and have authority to control all aspects of Subcontractor’s work. Subcontractor’s site supervisor must be assigned to the project throughout the duration of the Subcontractor’s work.

9. **Pre-Installation Meeting**

Prior to mobilization, a pre-installation meeting will be held with each Subcontractor. These meetings will provide a general orientation of the site and related site-specific requirements. The pre-installation meeting will also incorporate a review of the Subcontractor’s scope of work, schedule, manpower requirements, submittal status, safety issues and quality control issues. Attendance by Subcontractor’s designated project manager and field supervision is required.

10. **Weekly Coordination Meetings**

MCI will hold weekly meetings with all subcontractors at the jobsite. Each Subcontractor shall have a qualified representative at this meeting each week. The Subcontractor’s representative shall have the authority and capability to make financial and schedule decisions concerning the Subcontractor’s work. The time and day of these meetings will be established and coordinated by MCI’s Project Superintendent.

11. **Working Hours**

MCI’s Project Superintendent will establish the project’s working hours. All contractors on the project will start and stop according to the same work hours unless authorized in advance by MCI’s site superintendent.

12. **Closeout**

Operation & Maintenance information, as-builts, and warranties are required before project completion. Electronic and hard copies of all closeout documents will be required at the cost of the subcontractor/supplier. For trades with multiple material or equipment information, include an index and separate files for each equipment or material type. Owner manuals shall be provided to MCI prior to final billing, start up or Owner’s training and includes the following:
Owner Manuals and Warranties

a) Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
b) Operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
c) Names and addresses of at least one service agency.
d) HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined set points shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
e) A complete narrative of how each system is intended to operate, including suggested set points.
f) It is preferred that complete air and water balance reports be included as part of the Owner’s Manuals. Reports may be provided after Owner’s training.

As-Built Documents

Provide marked up as-built drawing information indicating any project changes or other as-constructed information. Include elevations and survey information for hidden information such as site utilities. Submit as-built information in electronic (pdf) format prior to final billing.

MCI will not release final payment or retainage amounts until all final closeout documentation is submitted and approved. This includes owner manuals, as-built documents, spare parts, warranty documentation, and testing reports.

13. Submittal Procedure

Submittals must be made in a timely and sequential manner in accordance with the project construction schedule. Time must be allowed for review of submittal information prior to purchase and/or installation of the material or equipment.

Architect’s/Engineer’s and/or MCI’s review of shop drawings is for general compliance with the construction documents and does not relieve the Subcontractor/Vendor from the responsibility for errors and for compliance with the Contract Documents.

Submittals shall be in electronic format by the Subcontractor or Supplier and will be submitted through McPherson Contractors, Inc. document management software. To make a submittal electronically, please contact the project assistant to receive instructions.

14. Commissioning

The following standard level of commissioning is required for all equipment and systems in your scope of work for this project. Additional commissioning requirements in the contract documents, drawings and specifications, jurisdictions having authority and/or manufacturers will take precedence over this; however, will not replace these standard requirements:
A. Submit to McPherson Contractors, Inc. for approval, prior to beginning start up activities:
   1) Equipment and Systems Index (a comprehensive list taken off the construction documents for your scope of work.)
   2) Start up checklists to be used during each piece of equipment start up.
   3) I/O point-to-point test sheets to be used to validate control systems Input & Output operation.
   4) System functional test sheets to be used to validate control systems sequence of operations.

B. Project mechanical equipment may be utilized for temporary conditioning for the project and if so, will be started-up early. The warranty on these units shall be extended so the owner will receive full benefit of the 1 year warranty period (or longer warranty period if required by contract or project specifications) from the date of owner acceptance and substantial completion regardless of the specific date of equipment start-up. Any additional costs related to the extended warranty or start-up are the responsibility of the subcontractors.

C. Submit completed equipment/system start-up checklists, point-to-point test sheets and functional test sheets to McPherson Contractors, Inc. immediately after completing start up and testing for each piece of equipment/system, especially the HVAC Control System.

D. Complete owner training as required by project requirements. Provide training attendance records with the names and signatures of persons who attended each training session, a written description of the training material covered and the date(s) training occurred. At the discretion of the Owner or MCI, training sessions may be required to be videotaped by subcontractor.

E. Submit originals of the equipment and systems index, completed start up forms, completed system test sheets and owner training records bound together with final project closeout documents.

F. Attend and participate in on-site MEP coordination meetings.

15. **Project Site Temporary Power & Light**

   (including temporary construction offices and storage facilities):

The Electrical Subcontractor will provide power to distribution points within the building. Each subcontractor shall provide extension cords for their own forces.

At a minimum, general temporary lighting to meet minimum OSHA requirements will be provided and installed by the Electrical Subcontractor. Additionally, task lighting or general lighting required beyond minimum requirements shall be provided and maintained by the Electrical Subcontractor.

McPherson Contractors, Inc. is not responsible for connection to, or power usage of electrical power to subcontractor’s temporary offices or storage areas.
16. **Water**

Each Subcontractor shall provide ice, water, cups, dispensers, and trash containers for all of their employees during the course of the work. All paper drinking cups shall be properly disposed.

17. **Temporary Ladders / Stairs**

Each Subcontractor shall provide ladders as necessary for work performed by their own forces.

Roofing, Steel, Precast, Masonry, and Formwork Subcontractors shall provide temporary access to all areas of work where permanent access is not available or in place. This access will be installed and maintained pursuant to all applicable OSHA standards.

18. **Material Storage & Deliveries**

Storage of materials on site shall be arranged and cleared with the Project Superintendent. Although effort will be made to accommodate on site material storage requirements for each Subcontractor, adequate space and/or continued use of such locations are not guaranteed. Upon request by MCI, the Subcontractor will relocate, at his own expense, his material and equipment as required for building and site work progress.

Arrange deliveries in accordance with the most recent construction schedule. Coordinate time, sizes and weights for all deliveries with the Project Superintendent. All materials must be palletized or bundled, no loose material will be permitted.

Subcontractors are responsible for proper storage and protection of all materials whether stored on site in the building, on-site at a laydown area or offsite.

The storage of materials and supplies within the building will be permitted only to the extent approved by MCI. A maximum of three days’ supply of building materials will be allowed within the building area. If materials stored in the building obstruct the progress of any portion of the work, they shall be moved upon notification without reimbursement of cost.

19. **Cleanup**

*Identifiable Debris:*

Good housekeeping is important to the safe and efficient progress and is the responsibility of each employer. Subcontractors are responsible for their individual work areas and the debris resulting from their work. All work areas, shall be kept orderly and clear of obstructions and debris at all times.

It is each Subcontractor’s responsibility to make arrangements to remove all cartons, crates and boxes at the end of each day. All boxes, crates and material are to be reduced to the minimum dimensions to utilize dumpster space.

Dumpsters are provided; however, waste that is not acceptable (petroleum products, tires, batteries, paint products, and hazardous materials) to the hauler is the responsibility of the Subcontractor to properly dispose of off-site.
The Subcontractors shall not cause any dirt or debris to be deposited on any roadways and must immediately clean up same if it occurs. All subcontractors and material suppliers shall comply with the storm water prevention plan with regard to site and roadway care.

If clean-up activities are not performed on a regular (daily) basis, then MCI reserves the right to perform this clean up with all attributable costs charged to Subcontractor.

**Unidentifiable Debris:**
A clean-up crew will be formed (at Subcontractor’s expense) with individuals from all contractors on site for the express purpose of general job clean up. This crew will be assembled a maximum of twice a week. The following table will be used to determine the number of workers each contractor shall supply to the composite crew:

<table>
<thead>
<tr>
<th>Subcontractor Employees on Site</th>
<th>Workers to be Provided</th>
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</thead>
<tbody>
<tr>
<td>1-3</td>
<td>1</td>
</tr>
<tr>
<td>4-14</td>
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<td>26-60</td>
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</tbody>
</table>

**20. Infectious Control**

If applicable, the project may require an infectious and/or noise control plan. All subcontractors are required to follow the plan accordingly without additional cost or time to the project.

**21. Joint Checks**

MCI may require joint check agreements with any and all subcontractor suppliers.

**22. Procore**

All Subcontractors/Suppliers awarded will be required to complete the Subcontractor and Supplier Certification Modules through Procore prior to commencement of construction and utilize Procore Project Management on this project. There is no cost to the subcontractor/supplier and the number of users is up to all parties. This tool will be used for the current pre-construction and construction documentation to include, current set, addenda, Submittals, RFI’s, ASI’s, change orders, applications for payment, As-Built Conditions, QA/QC, Punch Lists and Closeout documents. At a minimum, onsite personnel will be required to use this tool to facilitate communication. It is recommended that an office administrator assist field personnel.

End of Division 1
SUBCONTRACT

Enclosed is one copy of the Subcontract Agreement for your review and signature for the above referenced project. Please sign and return one copy via fax or email. Fax or email signatures on the subcontract agreement will be accepted by all parties as original.

INSURANCE AND TAXES

We require a copy of your current insurance certificate showing appropriate coverage as outlined in the specifications and Section 9 of the Subcontract Agreement. McPherson Contractors, Inc. and McPherson Development Co., Inc. shall be listed as additional insured on this project. The project name shall be: ___________________________. Prior to commencing work or stocking material on the jobsite, please have your insurance carrier forward your certificate to our office. A sample of an Acord Insurance Certificate is enclosed for your use.

This project is/ is not exempt from sales tax. Accordingly, the exemption certificate is enclosed for your use.

Complete and return the “Hold Harmless Agreement” covering the use of any equipment provided by McPherson Contractors, Inc. or McPherson Development Co. Inc. (Enclosed)

Complete and return the “W-9 Request for Tax Payer Identification Number and Certification” (enclosed).

PAYMENTS AND SUBCONTRACTOR’S MATERIAL SUPPLIERS LIST

Applications for payment are due in our office on or before the 25th day of each month. All payment requests must be on AIA G702 and AIA G703 forms. You may fax the application, but an original signed copy is required for payment. A waiver of lien will accompany each payment, it is to be signed and returned to our office before the next payment can be processed.
SUBMITTALS
Submittals must be made in a timely and sequential manner in accordance with the project construction schedule. Time must be allowed for review of submittal information prior to purchase and/or installation of the material or equipment.

Architect’s/Engineer’s and/or MCI’s review of shop drawings is for general compliance with the construction documents and does not relieve the Subcontractor/Vendor from the responsibility for errors and for compliance with the Contract Documents.

Submittals shall be in electronic format by the Subcontractor or Supplier and will be submitted through McPherson Contractors, Inc. document management software. To make a submittal electronically, please contact the project assistant to receive instructions.

SAFETY
All McPherson Contractors, Inc. and McPherson Development Co., Inc. jobsites are hard hat required areas. All equipment must be OSHA compliant and be checked by a competent person each day. You will need to provide your jobsite foreman and our superintendent a manual with your Hazardous Communication Written Program and Material Safety Data Sheets for the materials you will be using on this project. Periodically, OSHA inspectors will make a visit to the jobsite and review our procedures for handling hazardous materials/equipment and our policies for the training of employees in safety practices to be followed. Unsafe practices will not be tolerated.

CHECKLIST - RETURN BACK TO OUR OFFICE (prior to commencement of work and before any payments can be processed):
1. Signed subcontract agreement
2. Completed Acord insurance certificate listing McPherson Contractors, Inc. and McPherson Development Co., Inc. as additional insured.
3. Completed “W-9 Request for Tax Payer Identification Number and Certification” form
4. Completed “Subcontractors and Materials Suppliers List” form
5. Completed “Subcontractor’s Project Information” form
6. Signed “Hold Harmless Agreement”

We look forward to working with you on this project. Please feel free to contact me if you have any questions.

Sincerely,

Project Assistant

Enclosures: Subcontract, McPherson Project Contact Information, Subcontractor’s Project Information, Subcontractors and Material Supplier List, Hold Harmless Agreement, Sample Insurance Certificate, W-9, Change Order Breakdown Form, AIA Payment Form, Sales Tax Exemption Form (If Applicable)

C: File
McPherson Contractors, Inc. Project Contact Information

PROJECT SUPERINTENDENT:

Name: ____________________________, Phone Number(s): ____________________________

Email: ____________________________

PROJECT MANAGER:

Name: ____________________________, Phone Number(s): ____________________________

Email: ____________________________

PROJECT ASSISTANT:

Name: ____________________________, Phone Number(s): ____________________________

Email: ____________________________
Subcontractor’s Project Contact Information

SUBCONTRACTOR SUPERINTENDENT:

Name: ___________________________  Phone Number(s): ___________________________

Email: ___________________________

SUBCONTRACTOR PROJECT MANAGER:

Name: ___________________________  Phone Number(s): ___________________________

Email: ___________________________

SUBCONTRACTOR OFFICE ASSISTANT:

Name: ___________________________  Phone Number(s): ___________________________

Email: ___________________________
Subcontractors, Material Suppliers & Equipment Rental Companies List

Project Name:  insert project name here

Subcontractor:  
Phone:  Fax:  

Please provide us with the job specific information requested below. We may contact your subs, material suppliers and equipment rental companies to verify that you are current with your payments. Per our subcontract agreement, we reserve the right to enter into a joint check agreement with these subcontractors, suppliers or equipment rental companies at any time. List only companies with whom you anticipate purchases exceeding $1,000 for this job. If a substantial portion of your material is from stock, please note that as your first supplier below.

Sub/Supplier/Equipment Rental Co.:  Estimated Purchase Amount:  
Phone:  Fax:  
Contact Name/Address/Brief Work and Material Description:  

Sub/Supplier/Equipment Rental Co.:  Estimated Purchase Amount:  
Phone:  Fax:  
Contact Name/Address/Brief Work and Material Description:  

Sub/Supplier/Equipment Rental Co.:  Estimated Purchase Amount:  
Phone:  Fax:  
Contact Name/Address/Brief Work and Material Description:  

Sub/Supplier/Equipment Rental Co.:  Estimated Purchase Amount:  
Phone:  Fax:  
Contact Name/Address/Brief Work and Material Description:  
Hold Harmless Agreement

Hold Harmless Agreement between:

McPherson Contractors, Inc. and McPherson Development Co., Inc. (Contractor)

And

________________________________________ (Subcontractor)

Dated this _____ day of ________, 200__

Project Name:

The Subcontractor may occasion to use materials, tools and/or equipment provided at any time during the referenced project by the Contractor. The Subcontractor shall indemnify, defend and hold harmless the Contractor and its officers, employees and associates, of and from any and all claims, demands, causes of actions, suits, liens and other liabilities of whatsoever nature, included related expenses and attorney fees, whether for personal injuries, death, property damage or otherwise, arising out of or in any way connected with the use of any materials, tools and equipment.

The Subcontractor will allow no other person or entity to use these materials, tools and equipment.

The Subcontractor will promptly repair, replace or, at the Contractor’s option, reimburse the Contractor any reasonable cost of repairing or replacing any damage that is caused by the use of any materials, tools and equipment by the Subcontractor.

The Contractor makes no warranty or representation of any kind with respect to the fitness of said materials, tools and equipment.

McPherson Contractors, Inc. and McPherson Development Co., Inc. (Contractor)

________________________________________
Signature

______________________________
Printed Name

______________________________
Title

________________________________________ (Subcontractor)

______________________________
Signature

______________________________
Printed Name

______________________________
Title
# Change Order Breakdown Form

**Date:**

**To (Project Manager):**

**Subcontractor/ Supplier Name:**

**Subcontractor/ Supplier Phone #:**

**Bulletin # and/ or ASI #:**

**Description of Work to be performed or deleted:**

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<th>Labor Unit Cost</th>
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</table>

**SUB TOTAL**

**OVERHEAD & PROFIT**

**TOTAL** $0.00
**ACORD CERTIFICATE OF LIABILITY INSURANCE**  
**DATE (MM/DD/YY) Issue Date**

**PRODUCER**

Subcontractors Agent

Name

And Address

**INSURER(S) AFFORDING COVERAGE**  
**NAIC#**

INSURED

Subcontractors Name

And Address

**CERTIFICATE OF LIABILITY INSURANCE**

---

**COVERAGES**

**SAMPLE CERTIFICATE OF INSURANCE**

The policies of insurance listed below have been issued to the insured named above for the policy period indicated. Notwithstanding any requirement, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the policies described herein is subject to all the terms, exclusions and conditions of such policies. Aggregate limits shown may have been reduced by paid claims.

<table>
<thead>
<tr>
<th>INS LTR</th>
<th>TYPE OF INSURANCE</th>
<th>ADDL INSR</th>
<th>SUBR WWD</th>
<th>POLICY NUMBER</th>
<th>POLICY EFF (MM/DD/YY)</th>
<th>POLICY EXP (MM/DD/YY)</th>
<th>LIMITS</th>
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<tr>
<td>A</td>
<td>GENERAL LIABILITY</td>
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<td></td>
<td>POLICY NUMBER</td>
<td>Effective Date</td>
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<td>COMMERCIAL GENERAL LIABILITY</td>
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<td>EACH OCCURRENCE $1,000,000</td>
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<td>CLAIMS MADE ☑ OCCUR</td>
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<td>DAMAGE TO RENTED PREMESIS (Ea occurrence) $100,000</td>
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<td>GEN'L AGGREGATE LIMIT APPLIES PER:</td>
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<td>MED EXP (any one person) $5,000</td>
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<td>POLICY ☑ PROJECT LOC</td>
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<td>PERSONAL &amp; ADV INJURY $1,000,000</td>
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<td>ANY AUTO</td>
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<td>POLICY NUMBER</td>
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<td>ALL OWNED AUTOS</td>
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<td>BODILY INJURY (Per person) $</td>
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<td>BODILY INJURY (Per accident) $</td>
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<td>PROPERTY DAMAGE (Per accident) $</td>
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<td>B</td>
<td>WORKER’S COMPENSATION AND EMPLOYER’S LIABILITY</td>
<td></td>
<td></td>
<td>POLICY NUMBER</td>
<td>Effective Date</td>
<td>Expiration Date</td>
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<tr>
<td></td>
<td>ANY PROPRIETORY/PARTNER/EXECUTIVE OFFICE MEMBER EXCLUDED? Y ☑ N ☐ (Mandatory in NH)</td>
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<td>E.L. EACH ACCIDENT $500,000</td>
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<td>If yes, describe under DESCRIPTION OF OPERATIONS below</td>
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<td></td>
<td></td>
<td>E.L. DISEASE -EA EMPLOYEE $500,000</td>
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<tr>
<td>C</td>
<td>OTHER</td>
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<td></td>
<td>POLICY NUMBER</td>
<td>Effective Date</td>
<td>Expiration Date</td>
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</tbody>
</table>

**DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES** (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

The Certificate holder is named as an additional insured, excluding Worker’s Compensation, on a Primary and non-contributory basis; Waiver of Subrogation is included as allowed by law. Project Name, Project Location, and Project Address. McPherson Contractors, Inc. and McPherson Development Co., Inc. are Additional insured. No residential or subcontracted work exclusions are on the policy.

**CERTIFICATE HOLDER**

McPherson Contractors, Inc.
McPherson Development Co., Inc.
3501 SW Fairlawn Rd, Suite 100
Topeka, KS 66614

**AUTHORIZED REPRESENTATIVE**

Should any of the above described policies be cancelled before the expiration date therefor, 30 day notice will be delivered in accordance with the policy provisions to the certificate holder.

**AUTHORIZED SIGNATURE**

The procedures outline below must be followed in issuing the required certificate of insurance:

1. The sample ACORD form shows minimum coverage and limits as required by your subcontract agreement.
2. The description of operations shall indicate the project name and location.
3. Include the following wording: "No residential or subcontracted work exclusions are on the policy.", or address separately.
4. McPherson Contractors, Inc. AND McPherson Development Co., Inc. are to be listed as both certificate holder and additional insured.
Form W-9

Request for Taxpayer Identification Number and Certification

Give form to the requester. Do not send to the IRS.

Name (as reported on your income tax return)

Business name, if different from above

Check appropriate box: Individual/ Sole proprietor Corp. Partnership Other □

Exempt from backup withholding □

Address (number, street, and apt. or suite no.)

City, state, and ZIP code

List account number(s) here (optional)

Part I
Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see "How to get a TIN" on page 3.

Note: If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Part II
Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or if I am waiting for a number to be issued to me), and

2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest and dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and

3. I am a U.S. person (including a U.S. resident alien).

Certification instructions. You must cross out Item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, Item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. (See the instructions on page 4.)

Social security number

or

Employer identification number

Sign Here ➤

Signature of U.S. person ➤

Date ➤

Purpose of Form

A person who is required to file an information return with the IRS, must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

U.S. person. Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),

2. Certify that you are not subject to backup withholding, or

3. Claim exemption from backup withholding if you are a U.S. exempt payee.

Note. If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester’s form if it is substantially similar to this Form W-9.

For federal tax purposes you are considered a person if you are:

• an individual who is a citizen or resident of the United States,

• a partnership, corporation, company, or association created or organized in the United States or under the laws of the United States, or

• any estate (other than a foreign estate) or trust. See Regulation section 301.7701-9(a) for additional information.

Foreign person. If you are a foreign person, use the appropriate Form W-8 (see Publication 515: Withholding of Tax on Nonresident Aliens and Foreign Entities).

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

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

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.

2. The treaty article addressing the income.

3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.
APPLICATION AND CERTIFICATE FOR PAYMENT

TO OWNER: McPherson Contractor, Inc.
3501 SW Fairlawn Road
Topeka, Kansas 66614

FROM CONTRACTOR: VIA ARCHITECT:

APPLICATION NO.: Distribution to:
PERIOD TO: □ OWNER
PROJECT NOS.: □ ARCHITECT
□ CONTRACTOR
CONTRACT DATE:

The undersigned Contractor certifies that to the best of the Contractor’s knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Document, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is new due.

CONTRACT FOR:

CONTRACTOR’S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G701, is attached.

1. ORIGINAL CONTRACT SUM ..................................................$

2. Net change by Change Orders ............................................$

3. CONTRACT SUM TO DATE (Line 1 ± 2) ..................................$

4. TOTAL COMPLETED & STORED TO DATE .........................$

5. RETAINAGE:
   a. 10% of Completed Work  ..............................................$
   (Columns D + E on G701)
   b. 10% of Stored Material .............................................$
   (Column F on G703)

Total Retainage (Line 5a + 5b or
Total in Column I of G703) ..................$

6. TOTAL EARNED LESS RETAINAGE .....................................$
   (Line 4 less Line 5 Total)

7. LESS PREVIOUS CERTIFICATES FOR PAYMENT
   (Line 6 less prior Certificate) .............................................$

8. CURRENT PAYMENT DUE ..................................................$

9. BALANCE TO FINISH, INCLUDING RETAINAGE
   (Line 3 less Line 6) .........................................................$

<table>
<thead>
<tr>
<th>CHANGE ORDER SUMMARY</th>
<th>ADDITIONS</th>
<th>DEDUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total changes approved in Previous months by Owner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total approved this Month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NET CHANGES by Change Order</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ARCHITECT’S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect’s knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..................................................$

(Attach explanation if amount certified differs from the amount applied for: Initial all figures on this Application and on the Continuation Sheet that are changed to conform to the amount certified.)

ARCHITECT:

By: ____________________________ Date: ____________________________

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.
AIA® Document G703™ - 1992

Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>DESCRIPTION OF WORK</th>
<th>SCHEDULED VALUE</th>
<th>WORK COMPLETED</th>
<th>MATERIALS PRESENTLY STORED (NOT IN D OR E)</th>
<th>TOTAL COMPLETED AND STORED TO DATE (D+E+F)</th>
<th>% (G-C)</th>
<th>BALANCE TO FINISH (C-G)</th>
<th>RETAINAGE (IF VARIABLE RATE)</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>$ 0.00</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
<td>0.00 %</td>
<td>$ 0.00</td>
<td>$ 0.00</td>
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</tbody>
</table>

GRAND TOTAL

$ 0.00 $ 0.00 $ 0.00 $ 0.00 $ 0.00 0.00 % $ 0.00 $ 0.00

DRAFT
SUBCONTRACT AGREEMENT
MCI/MDI version 2016-3

THIS DOCUMENT HAS IMPORTANT LEGAL CONSEQUENCES: CONSULTATION WITH AN ATTORNEY IS ENCOURAGED WITH RESPECT TO ITS COMPLETION OR MODIFICATION.

THIS AGREEMENT, Made this ___ day of __________ , 20 __, by and between 
___________________________________________________________________________________________, 
hereinafter called "Subcontractor", and 
McPHERSON____________________________________, INC., 3501 SW Fairlawn Rd., Suite 100, Topeka, Kansas 66614, (785) 273-3880, FAX (785) 273-1037, hereinafter called "Contractor, General Contractor, or Construction Manager".

WITNESSETH: That the Subcontractor and Contractor for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, agree as follows:

SECTION 1: THE PROJECT

1.1 The Contractor has entered into a contract for the construction of

Project Name
Project Address

hereinafter called the "Project", with:

Owner Name

hereinafter called "Owner", at:

Owner Address

which contract is referred to as the “Prime Contract.” The Project is to be constructed in accordance with the general conditions and special conditions of the Prime Contract between Owner and Contractor, and in accordance with the plans, drawings, and specifications prepared by ____________________________________________hereinafter called "Architect" (Architect shall also refer to Engineer, or any Designer of the Project), all of which general conditions, supplementary conditions, special conditions, plans, drawings, specifications, unit prices, addenda, and alternates which are made a part of the Prime Contract or identified by the Architect are referred to as the "Contract Documents" and are a part of the Subcontract Documents, which are made a part of this Subcontract Agreement.

Amendments & Addenda: __________
Alternates: __________

SECTION 2: THE SUBCONTRACT DOCUMENTS

2.1 The Subcontract Documents shall consist of this Subcontract Agreement and any addenda, the Prime Contract entered into by the Contractor and the Owner and other Contract Documents identified therein, modifications of the Prime Contract regardless of when made, modifications to this Subcontract, the drawings, plans and specifications, issued prior to and any modifications, change orders, or amendments issued in writing after the execution of this Subcontract.

2.2 The Subcontractor acknowledges that the Subcontract Documents have been made available to it and that Subcontractor has carefully examined the Subcontract Documents or has had an opportunity to examine them and has declined to do so. The Subcontractor shall be furnished copies of the Subcontract Documents upon request, but Contractor may charge the Subcontractor for the reasonable cost of reproduction.
SUBCONTRACT AGREEMENT
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2.3 The Subcontractor agrees to be bound by the applicable provisions of the Contract Documents between the Owner and Contractor, and accepted alternates thereto, and to assume toward the Contractor all of the obligations and responsibilities that the Contractor by the Contract Documents assumes toward the Owner, insofar as they are applicable to the Subcontractor’s Work to be performed under this Subcontract.

2.4 Subcontractor shall assume and be responsible for all job site responsibilities that are assumed by the Contractor under the Prime Contract between Owner and Contractor and the Contract Documents, insofar as they are applicable to the Work to be performed under this Subcontract, except as follows:

enter none or exceptions

2.5 Subcontractor warrants and agrees that all requisite approvals from the Owner as to its eligibility to serve as a Subcontractor and approval of all materials and performance of work as required by the Contract Documents are obtainable.

SECTION 3: THE SUBCONTRACT WORK

3.1 Subcontractor agrees to furnish all necessary shop drawings, materials, labor, tools, equipment, services, supplies, and other incidentals necessary to perform all work and labor, in conformance with all applicable codes and standards of construction for the following work: GENERAL SCOPE OF WORK WITH SPEC SECTIONS

3.2 As part of performing its work under the terms of this Subcontract Agreement, Subcontractor agrees to provide the following: competent project management and competent field supervision fluent in the English language; coordination of its work with other trades; skilled labor; adequate equipment; all necessary hoisting, lifting and unloading equipment necessary to deliver its materials to the final locations; completion of every detail of its work; protection of its work; layout and control of its work; all incidental materials to complete its tasks; daily clean-up of its trade–debris taken outside and deposited in the dumpsters daily; attendance at weekly meetings; adherence to project schedules; adequate manpower to complete its work as quickly as possible; and, conduct weekly or daily safety meetings and adhere to all safety and OSHA standards. As part of performing its work under the terms of this Subcontract Agreement, Subcontractor further agrees to:

(a) Post all plan changes, addenda and change orders on all sets of drawings used in the field, all drawings will be updated with the latest information and AS-Built conditions, all required submittals and shop drawings will be reviewed and submitted within 20 calendar days of the receipt of this contract, or sooner;
(b) Review the shop drawings and submittals to be certain they are complete and accurate and reflect the conditions in the field;
(c) Ensure that its management and workers know and fully understand the Subcontract Documents, including the Contract Documents and perform each and every task assigned by this Subcontract in harmony with others.

3.3 Subcontractor acknowledges that it fully understands that everything on this Project is assigned to the Contractor, and the Contractor has assigned all duties of the Contractor to the Subcontractor as it relates to this Subcontract and its scope of work (example: note may say “general contractor to paint door”… the painting subcontractor will paint the door.) your firm will have all incidentals necessary to complete all furnishings and installation, of all GENERAL SCOPE OF WORK as outlined on the plans, specifications and required by the Subcontractor’s Work.

3.4 The Subcontractor’s Work includes, but is not necessarily limited to, DETAILED SCOPE OF WORK work as outlined or referenced in the Contract Documents, including the Specifications, as indicated in the Drawings, including amendments and addenda thereto, all change orders and change directives, and as required to properly complete construction of the Project and perform the craft or trade identified.

3.5 The Subcontractor shall have a continuing duty to provide and update its list of suppliers.

3.6 The Subcontractor recognizes that revisions in the planned schedules are inherent in the nature of construction and can result in changes to the schedules on which Subcontractor must perform its Work. The Subcontractor acknowledges that the Contractor cannot and does not guarantee either when Subcontractor will be able to begin work or whether Subcontractor will be interrupted in performing its Work. The Subcontractor’s Work shall be commenced, performed and
completed on the schedules developed by the Contractor and as amended by the Contractor from time to time.

3.7 If any part of Subcontractor’s work depends on the work of Contractor or any other subcontractor, Subcontractor shall inspect such work and promptly report to Contractor in writing any defects or inadequate performance, which adversely affects Subcontractor’s work. Failure to make such report within twenty-four (24) hours of Subcontractor’s discovery of the defect or inadequate performance, whether such discovery is actual or constructive, shall be deemed a waiver of any claim relating to same. If there appear to be any defects, variations or discrepancies of dimensions, quantities or other matters set forth in the plans, specifications and other portions of the Prime Contract and Contract Documents, Subcontractor will promptly notify Contractor of same in writing. Failure to provide such written notice within twenty-four (24) hours of the discovery of same, whether such discovery is actual or constructive, shall be deemed a waiver of any claim related to such defect, variation or discrepancy.

3.8 Contractor reserves the absolute right to delete labor, materials, sections of the specifications or any other part, portion or section of Subcontractor’s Work from this Subcontract. In such instance of deleted work, Contractor will provide Subcontractor with a Change Order setting forth the deleted work and the amount to be deducted from the Subcontract amount. The amount to be deducted from the Subcontract amount shall be the greater of the amount specified for the work on Subcontractor’s bid or schedule of values or the amount Contractor could reasonably pay for the deleted work.

SECTION 4: THE WORK SCHEDULES

4.1 Subsequent to the execution of this subcontract agreement, the Contractor may, in its discretion, prepare, and from time to time update a schedule that details the timing and sequence of the work to be performed by the Subcontractor on the Project. Subcontractor agrees that such schedule and updates shall be a part of its obligations under this Subcontract. Failure to comply with such a schedule or update, as determined in the Contractor’s discretion, shall constitute a breach of this Subcontract.

4.2 Subcontractor shall perform the work in accordance with the schedule or schedules prepared by the Contractor. Subcontractor shall cooperate with Contractor in scheduling and performing Subcontractor’s Work to avoid conflicts or interference with the work of other trades and to insure an efficient project. Subcontractor shall be liable to Contractor for failure to adhere to Contractor’s schedule, including amendments, even if such schedule differs from schedules set forth in the Contract Documents or the time of completion called for in the Contract Documents. In agreeing to perform the work in accordance herewith, Subcontractor has taken into account and made allowance for delays which should be reasonably anticipated or foreseeable. If requested by Contractor, Subcontractor shall submit detailed schedules for the performance of this Work in a form acceptable to Contractor, which shall comply with all scheduling requirements of the Contract Documents. Contractor may, from time to time, in its sole discretion, make modifications and revisions to the schedules.

4.3 Subcontractor acknowledges that as construction progresses it may be necessary for Contractor to change the sequential order and duration of the various activities, including those contemplated by this Subcontract to account for unanticipated delays, occurrences and other factors which act to alter Contractor’s original schedule. Contractor may require Subcontractor, at no additional cost to Contractor, to prosecute Subcontractor’s Work in such sequence as the progress of the other subcontractors and the Project scheduled reasonably dictates. It is expressly understood and agreed that the scheduling and sequencing of the Work is an exclusive right of Contractor and that Contractor reserves such right to reasonably reschedule and re-sequence Subcontractor’s Work from time to time as the demands of the Project require without an additional cost or expense to be paid to Subcontractor.

4.4 Subcontractor shall carry on said Work promptly, efficiently and at a speed that will not cause delay in the progress of Contractor’s work or work of other subcontractors. If, in the opinion of Contractor, Subcontractor falls behind in the progress of the Subcontractor’s Work, Subcontractor may be directed to take such steps as deemed necessary to improve the rate of progress. These steps may include, without limitation, requiring Subcontractor to increase the number of shifts, personnel, overtime operation, days of work, equipment, plant, or other remedies. Subcontractor shall submit to Contractor for Contractor’s approval a schedule demonstrating how the required rate of progress necessary to meet the schedule will be implemented and monitored without additional cost to Contractor or
SUBCONTRACT AGREEMENT
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Owner. In no event, however, shall Subcontractor be entitled to any inefficiency, impact or other special or indirect charges or damages of any kind as a result of any acceleration or other schedule or sequence modifications.

4.5 For purposes of this provision, Subcontractor’s failure to perform shall include the failure of its lower tier subcontractors to perform. If Subcontractor is, in Contractor’s opinion, behind schedule with the Subcontractor’s Work, Subcontractor shall, at its own expense, work such overtime as Contractor may deem necessary to comply with the schedule and complete the Work. Subcontractor shall pay all extra costs resulting from his lack of diligence or failure to provide needed labor or materials to meet the schedule of Work. In the event Subcontractor is behind schedule, Contractor shall be entitled to withhold payments under the Subcontract until Subcontractor corrects the deficiency and complies with the Schedule. Should Subcontractor at any time refuse or neglect to supply sufficient skilled workmen or material of proper quality, or refuse to follow plans and specifications, or fail to pay for labor and materials for which it has received’ payment from the Contractor, fail in any respect to prosecute the work on its part to be performed, or fail in any other respect to comply with the terms of this Subcontract, the Contractor shall have the right, immediately upon written notice to Subcontractor to terminate Subcontractor’s right to proceed in whole or in part. In such event, notwithstanding anything in this Agreement to the contrary, Subcontractor shall not be entitled to any further payments hereunder, whether due or not, and Contractor shall have the right to retain the entire subcontract balance, earned or not, due or yet to become due, until the completion of the project. The Contractor may finish Subcontractor’s work by whatever method it may deem expedient and Subcontractor and its surety, if any, shall be liable to the Contractor for any cost occasioned thereby. Contractor shall be entitled to deduct all costs as a result of Subcontractor’s default from any and all funds withheld from Subcontractor, including, but not limited to Contractor’s general conditions and costs, costs of completion, costs of supervisions, costs of correction, all acceleration costs, attorney’s fees, architects fees, inspection or re-inspection charges, and clean-up costs. In the event the costs of completion exceed the Subcontract Agreement balance, the difference shall be paid by Subcontractor to Contractor with Contractor having the express right to pursue a prejudgment garnishment action to freeze said funds. In the event the Subcontract Agreement balance exceeds the costs of completion, Subcontractor shall be paid the difference. Contractor’s administrative costs shall be included in the calculation of costs of completion.

4.6 In the event the Prime Contract is terminated, suspended, or halted under its terms, or by the Owner, or by the terms of a consent to assignment of the Prime Contract, or by an order of court or other public authority, or Contractor elects to take action pursuant to Section 13, Contractor shall, at its sole option, have the right to terminate or suspend any of the Subcontractor’s Work as of the date of such action. In the event that work is terminated, Subcontractor shall only be entitled to the lesser of (i) the actual, direct costs of all labor and material expended on the job prior to the effective date of the termination or suspension plus a sum equal to ten percent (10%) of all such labor and material to cover overhead and profit, or, (ii) whatever sum Owner or Owner’s assignee has paid Contractor for the work performed by Subcontractor up to the time of termination or suspension. In no event shall Subcontractor be entitled (a) to anticipatory profit, consequential damages or other forms of damages for any termination or suspension; (b) to assert a claim in quantum meruit or any other measure of damages other than that stated herein; or (c) to receive a sum in excess of what Owner pays to Contractor for such work of Subcontractor. In the event of suspension of the work, Subcontractor shall receive such adjustment to its Subcontract as is allowed under the Prime Contract.

4.7 Contractor shall not be liable to Subcontractor for any damages (consequential, actual or otherwise) or additional compensation as a consequence of acceleration or delays caused by the Owner or any other person or event unless Contractor has recovered damages on behalf of Subcontractor from said person, it being understood and agreed by the Subcontractor that apart from recovery from said person, Subcontractor’s sole and exclusive remedy for delay shall be extension of time for performance of Subcontractor’s work under the guidelines and restrictions set forth herein. Contractor shall have no duty or obligation to pursue any claim for delay damages from any third party on behalf of Subcontractor. Extension of time shall be Subcontractor’s sole remedy for delay, inefficiencies or loss of productivity incurred as a result of delay or as a result of schedule amendments.

SECTION 5: PERFORMANCE OF THE WORK

5.1 The work to be performed under this agreement shall be commenced immediately upon notice. Subcontractor will provide the required manpower, material and equipment to comply with the Construction Schedule. Subcontractor
shall begin work, and shall carry the same forward promptly, efficiently, and at a speed as determined by Contractor. Subcontractor recognizes that revisions in the planning schedule are inherent in the nature of construction, which may result in revisions to the schedule of work during construction. Subcontractor acknowledges that Contractor cannot guarantee that Subcontractor will be able to start on any particular date, or continue without interruption once started. In the event that Subcontractor falls behind schedule, due to events not the fault of Contractor, Subcontractor shall work additional required hours, bring in additional materials or equipment, or take such other steps as may be deemed necessary in the opinion of Contractor to get back on schedule at no additional expense to Contractor.

**Required Project Completion:**

5.2 The Subcontractor shall prosecute the work undertaken in a prompt and diligent manner when such work or any part of it, becomes available, or at such other time or times as the Contractor may direct, in accordance with the schedule provided by the Contractor and as amended form time to time, and so as to promote the general progress of the entire construction, and shall not, by delay or otherwise, interfere with or hinder the work of other subcontractors or the Contractor. Any materials that are to be furnished by the Subcontractor shall be furnished in sufficient time to enable the Subcontractor to perform and complete his work within the time or times provided for herein. Should the Subcontractor fail to complete the work or deliver its materials within the time established, or otherwise fail to comply with the terms of this Subcontract or the Subcontract Documents resulting in delay of the Project so that substantial completion is delayed beyond the date required by the Contract Documents, Subcontractor shall be liable to Contractor for liquidated damages. The amount of the liquidated damages shall be the same amount provided for in the Contract Documents or $1,000.00 per calendar day, whichever amount is greater. The parties agree that liquidated damages as provided for herein would be appropriate because of the difficulty of determining the actual damages that the Contractor will suffer and that they are not a penalty. It is further agreed that the liquidated damages shall be deducted as such from the balance due the Subcontractor, or in the event such damages exceed the sum due or to become due to the Subcontractor, the Subcontractor shall be liable to the Contractor for such difference. In addition, Subcontractor shall indemnify and hold harmless Contractor from any and all liquidated damages or other delay damages assessed or charged to Contractor by the Owner as the result in whole or in part of any act or omission of Subcontractor. Whenever Contractor reasonably believes that it will be entitled to payment from Subcontractor pursuant to this paragraph, then Contractor is entitled, but not required, to withhold from amounts otherwise due Subcontractor an amount then believed by Contractor to be adequate to recover such payment.

5.3 Subcontractor shall be responsible for proper coordination of his work with that of the Contractor and other Subcontractors and when not actively engaged on the project shall keep informed of the progress of the work and shall be available, or have a representative available, at project meetings and at other times as necessary to assist with this coordination. Attendance at regularly scheduled jobsite, foreman, progress, scheduling, or safety meetings is mandatory. Subcontractor is responsible for any item discussed at any of these meetings even if Subcontractor has not attended meetings.

5.4 Should the Owner, Contractor or other Subcontractor delay the Subcontractor's work, the Contractor shall owe the Subcontractor therefore only an extension of time equal to the delay caused and only then if the Subcontractor makes written claim for delay to the Contractor within 48 hours of the start of the delay.

5.5 Subcontractor may be ordered in writing by Contractor, without invalidating this Subcontract to make changes in the Subcontractor’s Work (consisting of additions, deletions, or other provisions). As part thereof, and to the extent permitted by the Prime Contract and Contract Documents and agreed to by the Owner, the contract sum and the contract time may be adjusted. Subcontractor, shall submit promptly, when requested, and prior to the commencement of such changed or revised work, a written statement of any claim or adjustment to the Subcontract sum or Subcontract time which the Subcontractor intend to claim because of the revised work. The written statement shall be consistent with the requirements of the Contract Documents. If approved, a written change order shall be executed in accordance with the Contract Documents. No change order shall be valid unless Contractor’s designated Project Manager has signed it.

5.6 If Subcontractor requests a proper written Change Order but there is a dispute as to any part of the change, including but not limited to, the price of and time to complete such changed work, Contractor shall be entitled to issue a written directive to Subcontractor to perform such change and Subcontractor, shall be obligated to proceed with such
change, without either party admitting liability for the change or waiving its rights under this Subcontract. To the extent permitted by applicable law, it shall be an express condition precedent that Owner pay Contractor for said work before any payment shall be due Subcontractor for said work and Subcontractor hereby accepts the risk of non-payment as a result of the Owner’s refusal to pay. Subcontractor shall file with the Contractor within three (3) days from the date of commencing performance of said work, its written itemized estimate for the cost and time needed to perform the alleged extra work or changes to be made. Contractor agrees to submit Subcontractor’s itemized estimate to Owner for payment. If Subcontractor fails to submit the itemized estimate for cost or time associated with the change as required herein, Subcontractor waives all claims associated with the change and agrees to perform the change at no additional cost or time.

5.7 A request by the Subcontractor for any additional payment because of a claimed change in the Subcontractor’s Work will not be honored unless the change in the Work was authorized in writing by the Contractor.

SECTION 6: SUBCONTRACTOR’S ADDITIONAL OBLIGATIONS

6.1. Subcontractor shall perform all work in accordance with the Contract Documents, the instructions of the Contractor, and in a workmanlike manner. Subcontractor warrants its Work to Contractor on the same terms, and for the same period, as Contractor warrants the work to the Owner under the Contract Documents, but in no event shall such warranty be for any term less than twelve (12) months from the date of substantial completion of the entire Project. Subcontractor warrants that its labor and materials will not be defective, will comply with the Contract Documents, will be new (unless the Contract Documents specifically state otherwise), will be suitable for their intended use and will be constructed and installed in a good and workmanlike manner. Subcontractor’s warranty shall apply to all work and material performed by Subcontractor unless the Contract Documents contain a stricter standard in which case the stricter standard shall control. Upon demand of Contractor or Owner Subcontractor, shall immediately honor all warranties and correct any defective work or materials. In the event this subcontract is terminated for any reason, Subcontractor’s warranties, guaranties and indemnities shall survive such termination and be in full force and effect for the period of time prescribed in the Contract Documents.

6.2 To the fullest extent permitted by the applicable law, the Subcontractor agrees to indemnify and hold harmless the Contractor from any and all loss or damage, including personal injury and property damage, occasioned wholly or in part by any intentional or negligent act or omission of the Subcontractor or that of anyone directly or indirectly employed by the Subcontractor or performing work or supplying services or materials at the request of or under the direction of the Subcontractor or arising from the Subcontractor's breach of any obligation existing under the terms of this Subcontract Agreement, whether or not caused in part by any other party, including the Contractor, its officers, agents or employees.

6.3 The Subcontractor agrees to promptly pay when due for all labor, equipment, materials and supplies used or consumed in completing this contract and to indemnify and hold harmless the Contractor from any claim, lien, judgment, court costs and expenses, including attorney’s fees, and litigation expenses, including expert fees, incurred on account of Subcontractor's failure to comply with the terms of this contract. Subcontractor agrees that all funds received shall be used first for payment of labor, material, equipment, supplies and services related to this work and said monies shall not be diverted to satisfy obligations of Subcontractor on other contracts until all obligations under or in connection with this Subcontract are satisfied in full. Contractor may withhold any payment or pay directly or by joint check to sub-subcontractors or suppliers unless Subcontractor has furnished Contractor with evidence satisfactory to it that Subcontractor has paid such debts in full and performed all other obligations incumbent on Subcontractor.

6.4 Subcontractor agrees to not assign this contract or subcontract any of the work hereunder without the prior written consent of the Contractor.

6.5 Subcontractor shall give notices and comply with all laws, ordinances, rules, regulations, and orders of any public authority bearing on the performance of the Subcontractor’s Work under this Subcontract including but not limited to: The Occupational Safety and Health Act of 1970; Fair Labor Standards Act; building codes; federal, state and local tax laws; and Workers’ Compensation Acts. Subcontractor shall also defend and hold harmless Contractor and Owner from any and all liability, damages, fines, and costs arising out of Subcontractor’s failure to comply with all laws,
regulations and ordinances applicable to the work.

6.6 Insofar as the Contractor has any obligation, for affirmative action or otherwise, under applicable Equal Employment Opportunity Rules and Regulations and various other state and federal non-discrimination laws, as they apply to the various forms of non-discrimination in employment, and as they apply to the employment of handicapped, as well as that of Vietnam Era Veterans, then this obligation shall extend also to the employment practices of the Subcontractor.

6.7 Subcontractor shall effectively secure and protect his materials and Work at its sole expense.

6.8 In carrying out its Work, Subcontractor shall take any and all necessary precautions to protect properly the finished work of other trades and the Owner from damages caused by his operations. Subcontractor shall promptly reimburse Contractor and/or other subcontractors for damages caused to their materials and work caused by Subcontractor or anyone under its control or authority. Should Subcontractor fail to pay promptly for such damages, Contractor is hereby authorized to withhold an amount to cover such damages from any payments that become due hereunder or any other amounts Contractor may owe Subcontractor. If Subcontractor deems that surface of work to which his work is to be applied or affixed is unsatisfactory or unsuitable, written notification of said condition shall be given to Contractor before proceeding or taking on remedial action, otherwise Subcontractor shall be fully and solely responsible and liable for any and all expense, loss, or damages resulting from said condition and Contractor shall be relieved of all liability in connection therewith.

6.9 In accordance with the Hazardous and Toxic Substance Act, Subcontractor must submit to contractor two (2) copies of Subcontractor’s Hazard Communications Program and Material Safety Data Sheets for any hazardous chemicals Subcontractor may be using on the Project. Subcontractor is responsible for complying with all OSHA requirements included in the Hazardous and Toxic Substance Act, including but not limited to providing information to any workman on the project who may request the information. Subcontractor is responsible for verifying that all information included within the Hazard Communications Program and Material Safety Data Sheets is current and in compliance with OSHA at all times.

6.10 Subcontractor shall promptly amend and make good any defective or non-complying materials and/or workmanship to the entire approval and acceptance of Contractor and Owner and their representatives. Should Subcontractor refuse or neglect to proceed at once with the correction of rejected or defective materials and/or workmanship after receiving notice to do so, it is agreed that Contractor may have the defects remedied or changes made at the sole expense of Subcontractor. Alternatively, should Contractor so elect, Contractor is hereby authorized to withhold any amount which Contractor in its sole discretion deems necessary to cover such costs from Subcontractor’s subcontract balance or from any payment due Subcontractor. In the alternative, Subcontractor shall pay Contractor the costs of repairs upon demand of Contractor. The remedies described above shall not be exclusive, but shall be in addition to all others provided by this Subcontract and by law.

6.11 Subcontractor shall clean up and remove from the site, on a daily basis or as and when directed by Contractor, all rubbish and debris resulting from its work. Subcontractor shall also clean up to the satisfaction of the Contractor all dirt, grease, marks, etc., on the walls, ceilings, floors, fixtures, etc. deposited or placed thereon as a result of the execution of this Subcontract Agreement. If Subcontractor refuses or fails to perform this cleaning as and when directed by Contractor, the Contractor shall have the right and power to proceed with said cleaning and Subcontractor will, on demand, pay to Contractor the actual cost of said labor, plus a reasonable percentage of such costs to cover supervision, insurance, overhead, and other costs. Should Contractor so elect, Contractor is hereby authorized, in the alternative, to withhold an amount to cover such cost from any payments that become due hereunder or any other amounts Contractor may owe Subcontractor.

6.12 Subcontractor shall deliver to Contractor copies of shop drawings, cuts, samples, material lists, and other submissions, including mock-ups and temporary structures required by Contractor or the Contract Documents within sufficient time so as not to delay performance of the Project and within sufficient time for Contractor to submit the same within the time stated in the Contract Documents. Contractor’s review or approval of any shop drawings, cuts, samples, material lists and other submissions, including mock-ups or temporary structures, shall not to any extent, under any circumstances, alter the requirements of the Contract Documents for quality, quantity, finish, dimension,
design or configuration or constitute acceptance by Contractor of any method, material or equipment not ultimately acceptable to Owner or relieve Subcontractor from responsibility for errors of any sort or from the necessity of furnishing any work required by the Contract Documents.

SECTION 7: PAYMENT

7.1 The Contractor shall pay the Subcontractor for the complete performance of the Subcontractor’s Work, subject to authorized additions and deductions, the Contract Sum of ________________________

The contract sum is determined as follows:

- **Base Bid:** $00,000.00
- **TOTAL:** $00,000.00

The Subcontract price includes, and Subcontractor shall pay for, all labor; materials; tools; equipment; supplies; state, federal, local and all other applicable taxes; transportation; storage facilities; offices; telephones; shop drawings; competent supervision; temporary facilities and all other things necessary for performance of the Work covered by this Subcontract Agreement. Subcontractor shall give timely notices to authorities and secure and pay for all permits and governmental fees, licenses, inspections, testing and taxes necessary for the proper execution and completion of Subcontractor’s Work.

7.2 The Contractor shall pay the Subcontractor monthly progress payments based upon the Subcontractor’s estimates for partial payment as are approved by the Contractor less retainage in the amount specified in the Prime Contract or Contract Documents, or if none be so specified, then in the amount of 10%. Except as otherwise provide in this Subcontract, payment to Subcontractor is due within seven business days after receipt of payment from Owner. The acceptance of any such work and payment therefore shall not relieve Subcontractor from liability for defects in such work, which may thereafter be discovered.

To the extent permitted by applicable law, the Subcontractor agrees that the Contractor shall be under no obligation to pay the Subcontractor for any work done on the Project until the Contractor has been paid therefore by the Owner and the provisions of this agreement stating the time and progress and final payments and the amount of them are subject to the condition precedent that the Contractor shall receive from the Owner progress or final payments in, at least, the amounts payable to the Subcontractor on this Project; otherwise the time when payment shall be due the Subcontractor shall be postponed until the Contractor has received same from the Owner. The Subcontractor hereby acknowledges that to the extent permitted by applicable law, payments to it are contingent upon the Contractor receiving payment from the Owner, and the Subcontractor expressly agrees to accept the risk that it will not be paid for work performed by it if the Contractor, for whatever reason, is not paid by the Owner for such work. The Subcontractor represents that payment for work performed will be based primarily on the credit and ability to pay of the Owner, and not on that of the Contractor, and the Subcontractor agrees that payment by the Owner to the Contractor for work performed by the Subcontractor shall be a condition precedent to any payment obligation for the Contractor to the Subcontractor.

7.3 Applications for monthly progress payments shall be in writing on the form AIA, G702 and G703 and in accordance with this Subcontract, shall state the estimated percentage of the Subcontractor’s Work in the Subcontract that has been satisfactorily completed and shall be submitted to the Contractor on or before the 25th day of each month. Contractor, Architect and/or Owner shall have the right to receive from Subcontractor such data, vouchers, receipts, invoices or other documents or information as they may require in order to verify the information contained in Subcontractor’s estimate. Materials purchased for the Project in accordance with approved shop drawings but not yet incorporated into the Project may be included in the application in accordance with the Contract Documents but shall at least be supported by detailed invoices from the material supplier and warehouse bonds or certificates of insurance. Material must be suitably stored at the Subcontractors expense, clearly marked for use on this project and segregated from other material in inventory. Failure of Subcontractor to make a timely submittal may result in said submittal being deferred for presentation to the Owner until the following month.

7.4 Prior to submitting its first application for payment, the Subcontractor shall submit an itemized schedule of values and a list of suppliers and subcontractors. The schedule of values shall be categorized according to the principal
elements of the work with labor, material and lower tier subcontract cost assigned to each element. This schedule, after approval by the Contractor, shall be used as the basis of payment. The list of subcontractors and suppliers shall include the names, addresses and telephone numbers of all suppliers and lower-tier subcontractors to be used by the Subcontractor on the Project. That list shall be immediately supplemented as new suppliers and/or lower-tier subcontractors become known to the Subcontractor. Applications based on valuation of work done shall meet the terms of contract between Owner and Contractor.

7.5 Subcontractor, if required, shall submit receipts or other vouchers showing payment of labor and material to the previous month’s date of estimate for partial payment. In the event Subcontractor does not furnish receipts and vouchers upon Contractor's request, Contractor is authorized to pay said bills directly and deduct such sums from the estimate for partial payment.

7.6 When the Subcontractor's Work or a designated portion thereof is complete, accepted by the Contractor and in accordance with the Contract Documents, the Contractor shall, upon application by the Subcontractor, make prompt application for payment of such Work. Within seven working days following receipt of payment by the Contractor from the Owner covering such completed Work, subject to the other provisions of this Subcontract, the Contractor shall, to the full extent provided in the Contract Documents, make payment to the Subcontractor of the entire unpaid balance of the contract sum or of that portion of the contract sum attributable to the completed work if the Subcontractor has supplied all requested releases and waivers. Provided however, the Contractor shall not be required to make any payment that would not leave a sufficient balance of the Subcontract Sum to cover all obligations of the Subcontractor for labor, materials, equipment or other obligations not paid for or to be furnished by the Subcontractor pursuant to the requirements of this Subcontract.

7.7 Final acceptance of any such work and payment therefore shall not relieve Subcontractor from liability for defects in such work, which may thereafter be discovered.

7.8 Contractor may withhold amounts otherwise due under this Subcontract or any other agreement between the parties to cover estimates of costs of liability Contractor has incurred or may incur for which Subcontractor may be responsible under this Subcontract or any other agreement between the parties. Contractor hereby reserves the right to settle, in its sole and absolute discretion, any and all claims arising out of Subcontractor’s Work with the Owner, Architect, or other subcontractor. If there are not sufficient amounts due Subcontractor under this Subcontract to cover all expenses related to the settlement of claims, Subcontractor shall pay Contractor for such expenses immediately upon demand.

7.9 Payment to Subcontractor is specifically agreed not to constitute or imply acceptance by Contractor or Owner of any portion of Subcontractor’s Work that fails to comply with the Contract Documents or is in any way unacceptable to Owner or Contractor.

7.10 Subcontractor agrees and covenants that all monies received by it for performance of this Subcontract shall first be used for, and that such sums constitute trust funds for, the payment of all labor and materials used in the Work. Subcontractor shall insure that all of its subcontractors, laborers, suppliers and employees are at all times timely paid all amounts due in connection with the Work. Contractor shall have the absolute right to withhold any payments due Subcontractor until Subcontractor submits evidence satisfactory to Contractor that all amounts owed in connection with the performance of this Subcontract have been fully paid. If Subcontractor does not: (a) supply evidence to the satisfaction of Contractor that the monies owing have been paid, or (b) post a bond indemnifying Owner, Contractor and the premises from an actual or potential claim or lien, then Contractor shall have a right to retain out of any payments due or to become due to Subcontractor a reasonable amount to protect Contractor from any and all loss, damage or expense, including attorneys’ fees, arising out of or relating to any such claim or lien, until actual or potential claim or lien has been satisfied by the Subcontractor.

7.11 Contractor shall have the express right of setoff for any sums due Subcontractor under this Subcontract Agreement against sums owed or claimed to be owed to Contractor by Subcontractor under this Subcontract Agreement or by virtue of any other agreement or contract by and between Contractor and Subcontractor or by operation of law. If Contractor elects, at Contractor’s option, to pay sums to cover labor payrolls, freight, express or material bills which Subcontractor has failed to pay promptly when due, then Contractor may deduct the amount of the
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payment plus an administrative charge of ten percent (10%) from any amounts due or that may become due to Subcontractor. Contractor reserves the absolute right, but shall be under no obligation, to pay suppliers or laborers of Subcontractor directly and Contractor may deduct same from Subcontractor’s Subcontract balance. Contractor maintains the absolute right, in its sole discretion, to issue joint checks made payable to the supplier, laborer or subcontractor and Subcontractor or to issue checks directly to the supplier, laborer or subcontractor of Subcontractor, any such payments constituting payment to Subcontractor under this Subcontract. Payments otherwise due Subcontractor may be withheld by Contractor on account of defective work not remedied, claims filed, evidence indicating probability of filing of claims, failure of Subcontractor to make payments to its subcontractors, laborers or suppliers, a doubt that the subcontract can be completed for the balance then unpaid or within the established schedule, or upon Contractor’s belief that it has incurred or is likely to incur damages due to Subcontractor’s Work or lack of performance of the Work.

7.12 If Subcontractor or any supplier, laborer, subcontractor or other claimant under Subcontractor should file any claim, lien notice or affidavit or bond claim against the Project, the Owner, Contractor or their respective sureties, Subcontractor shall immediately cause such lien, bond or claim to be released in full. Subcontractor shall provide Contractor an original, recordable release within three (3) days of demand of Contractor. If Subcontractor should fail to provide such original, recordable release, Contractor shall be authorized to take whatever action is necessary to remove such claim, including but not limited to providing a bond to indemnify against the claim or paying the claim, and Subcontractor shall be liable for all such costs including, but not limited to, bond premiums, interest, attorney’s fees and claims paid. The cost may, at Contractor’s option, be either deducted from Subcontractor’s remaining Subcontract balance, withheld from any payment due Subcontractor or payable on demand to Contractor.

7.13 Subcontractor agrees to pay its workmen not less than the scale of wages prescribed in the Contract Documents, or not less than the scale prescribed by law in case the Contract Documents provide no such scale, and to make payments at the times prescribed by the Contract Documents or by law. Should Subcontractor fail to observe this covenant, Contractor shall have the option to proceed with termination pursuant to Article 13 or exercise such other remedies as provided for in this Subcontract.

7.14 Subcontractor expressly agrees that as further consideration for the establishment of this Subcontract, and as an express condition precedent to receiving partial payment from Contractor for work performed pursuant to this Subcontract Agreement, Subcontractor and all of its suppliers and sub-subcontractors shall execute and deliver to Contractor with Subcontractor’s request for partial payments a full and complete release of all claims and causes of action Subcontractor may have or claim to have against Contractor through the date of the execution of said release, SAVE and EXCEPT for those claims which Subcontractor shall specifically list on said release and describe in a manner sufficient for Contractor to identify such claim with certainty. Such release shall also state that Subcontractor has paid all laborers, material suppliers and subcontractors through the date of the Release and will indemnify Contractor from any claims arising out of any such claims.

7.15 Title for all materials and work covered by estimates shall pass to the Contractor (or to the Owner, if the arrangements between the Contractor and Owner so provide). However, this provision shall not be considered as relieving Subcontractor from the sole responsibility for all materials and work for which payments have been made, the restoration of any damaged work or the maintaining of insurance thereon, if required by the Contract Documents: nor shall it be considered as a waiver of the right of Contractor or Owner to require fulfillment of all the terms of the Contract Documents.

7.16 Unless otherwise agree in a writing signed by the Contractor, Subcontractor shall continue to perform the Subcontract Work and meet the work schedule provided by the Contractor during any dispute resolution proceedings.

SECTION 8: PERFORMANCE AND MATERIAL BONDS

8.1 A Payment and Performance Bond will or will not be required. If required, the Subcontractor shall provide said bonds in forms and through a surety agreeable to Contractor and the bonds shall secure the faithful performance if the Subcontractor’s Work and to satisfy the Subcontractor’s payment obligations related to the Subcontractor’s Work.
9.1 Commercial General Liability Insurance. Subcontractor shall obtain and maintain Commercial General Liability Insurance with at least an “A-” rated carrier per A.M Best, on an occurrence form for the hazards of (i) construction operation, (ii) subcontractors and independent contractors, (iii) products and completed operations (with completed operations to remain in force for two years following project completion), (iv) explosion and collapse, (v) contractual liability, and (vi) the insurance will not contain exclusion(s) or endorsement(s) that limits insurance protection for work performed under this agreement, such as Residential Construction Exclusion or Subcontracted Work Exclusion (CG 2294 or its equivalent). Minimum limits of $1,000,000 per occurrence, $2,000,000 general aggregate and $2,000,000 products/completed operations aggregate will be maintained including a per project aggregate endorsement.

9.2 Business Automobile Liability Insurance. Subcontractor shall maintain automobile Insurance with at least an “A-” rated carrier per A.M Best covering all owned, non-owned and hired automobiles used in conjunction with the services or other work hereunder and shall have minimum bodily injury and property damage combined single limit of $1,000,000 per occurrences.

9.3 Workers Compensation and Employers Liability Insurance. Subcontractor shall maintain Workers Compensation Insurance with at least an “A-” rated carrier per A.M Best to cover the statutory limits of the Workers Compensation laws of the state in which any work is to be performed and when applicable to Federal Laws, USL&H if applicable and Employers Liability (including occupational disease) coverage with limits not less than:

- $500,000 Each Accident
- $500,000 Policy Limit for Disease
- $500,000 Each Employee for Disease

9.4 Excess Liability. Subcontractor shall maintain Excess Liability coverage with Minimum limits of $3,000,000 per occurrence and $3,000,000 aggregate.

9.5 Professional Liability. Subcontractor shall maintain coverage for Design-Build, Contractors Errors and Omissions and/or Contractors Professional Liability whereas the subcontractor is performing or subcontracting engineering, design-build, architectural and/or professional consulting services with minimum limits of $1,000,000 per occurrence and $1,000,000 aggregate.

9.6 To the extent permitted by the applicable law, the Contractor and Subcontractor waive all rights against each other and against the Owner, the Architect and/or the Engineers, separate contractors, and all other subcontractors, to the extent permissible under their respective and appropriate policies of insurance, for damages caused by fire or other perils to the extent covered by property insurance, except such rights as they may have to the proceeds of such insurance. The deductible portion of any claim against the Builders Risk Policy, if provided, is the responsibility of the subcontractor making the claim.

9.7 Additional Insured. Subcontractor furnished insurance (except Workers Compensation) shall name Contractor and all its assigns, subsidiaries and affiliates as, additional insured as their respective interests may appear including products and completed operations. Form CG 2010 11 85 if available or Forms CG 20 37 07 04 or CG 20 37 10 01 may be used in combination with CG 2010 07 04 or their equivalents. All coverage for additional insured shall be written on a primary and noncontributory basis. Sub-subcontractors shall also name Contractor as additional insured.

9.8 Sub-subcontractor's Insurance. Subcontractor shall require all those sub-subcontractors providing equipment, materials or services directly to Subcontractor in connection with this Subcontract to obtain, maintain and keep in force coverage in accordance with these insurance requirements set forth herein. Subcontractor shall obtain certificates of insurance evidencing such coverage and provide Contractor with such certificates. Subcontractor shall not be excused from its obligations to cause such subcontractor to meet the insurance coverage requirements set forth under this section unless Sub-contractor shall have obtained in writing from Contractor a waiver, which shall be effective only as to such requirements and for such sub-subcontractor specifically identified therein.
9.9 Certificates of insurance acceptable to Contractor shall be filed with Contractor prior to commencement of the Work. If any of the foregoing insurance coverages are required to remain in force after final payment, then an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment. Similarly, the Contractor, if requested by the Subcontractor, shall furnish satisfactory evidence of builders risk type insurance if required by the contract documents.

9.10 Indemnification Agreement: Subcontractor agrees to indemnify and save harmless the Contractor from any and all claims, loss, or expense, including attorney’s fees and litigation expenses, including expert fees which may arise directly or indirectly from the performance or failure of performance by Subcontractor of his obligations under this contract.

SECTION 10: COMPLIANCE WITH SAFETY REQUIREMENTS

10.1 Subcontractor shall take all necessary precautions for the safety of the employees on the Project and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injuries to persons or damage to property on or about or adjacent to the Project. Contractor and Subcontractor agree that Contractor does not owe a duty to ensure that Subcontractor performs its work in a safe manner. Subcontractor acknowledges and agrees that Contractor does not retain any actual or constructive control over the manner in which the Subcontractor performs its work. Subcontractor and not Contractor is responsible for constant supervision and monitoring of all its employees and laborers. Issues specifically requiring Subcontractor’s constant supervision and immediate correction in the case of unsafe conditions include, but are not limited to, cleaning of the project site; wearing of hard hats; keeping railings, barricades and covers in the proper place and in good repair; wearing all necessary protective equipment; keeping scaffolding and ladders in good repair and in proper use; and using power tools properly and keeping all tools in good repair.

10.2 The Subcontractor agrees to take all reasonable safety precautions with respect to its Work, to comply with all safety measures initiated by the Contractor for the safety of persons or property, and to perform all work in accordance with the requirements of the Contract Documents. The Subcontractor shall report to the Contractor within three days any injury to any other subcontractor's employees at the site.

10.3 Subcontractor agrees, in performance of this contract, to observe and comply (1) with the Occupational Safety and Health Act of 1970, as amended, and with the standards and rules issued thereunder and (2) with other federal, state, and local laws, ordinances and regulations. Subcontractor agrees to indemnify and hold Contractor harmless for, of, and from any loss including attorney’s fees and litigation expenses, including expert fees Contractor may sustain by reason of Subcontractor's failure to comply with said laws, rules and regulations or the requirements of the Subcontract in connection with the performance of said contract.

SECTION 11: COMPLIANCE WITH CIVIL RIGHTS ACTS

11.1 Subcontractor agrees in the performance of this contract, to observe and comply with all applicable federal and state laws against discrimination including the Civil Rights Act of 1964, as amended, the Age Discrimination in Employment Act, the Americans With Disabilities Act, and the Equal Pay Act, as well as all rules and regulations promulgated under the aforesaid acts, and require the same of its subcontractors and vendors.

11.2 Subcontractor agrees to indemnify and hold Contractor harmless for, of, and from any loss including attorney’s fees and litigation expenses, including expert fees Contractor may sustain by reason of Subcontractor's failure to comply with said laws, codes, rules and regulations in connection with the performance of said contract.

SECTION 12: COMPLIANCE WITH EMPLOYMENT SECURITY ACT

12.1 The Subcontractor agrees to furnish the Contractor, if required, an affidavit of the Department of Labor of the
SUBCONTRACT AGREEMENT
MCI/MDI version 2016-3

State of Kansas (or equivalent agent from other states having jurisdiction) that the Subcontractor has paid all contributions, penalties, and interest which Subcontractor is obligated by the Employment Security Laws of Kansas (or other states having jurisdiction) to pay on account of the work covered by this subcontract.

12.2 Subcontractor, in the event said affidavit is required, agrees that the Contractor may withhold final payment to Subcontractor until such date as Subcontractor furnishes to Contractor said affidavit of the Department of Labor of the State of Kansas (or equivalent agent from other states having jurisdiction)

12.3 Subcontractor further agrees that if it is necessary for Contractor to make any payment on behalf of the Subcontractor under the Employment Security Laws, and that if the amount so retained pending receipt of an affidavit from the Department of Labor of the State of Kansas (or other equivalent agent from other states having jurisdiction) is inadequate to make full payment thereof, Subcontractor shall be liable for, and shall pay to the Contractor such additional amount together with interest at the highest legal rate from the date of such payment.

SECTION 13: REMEDIES ON SUBCONTRACTOR'S BREACH

13.1 In the event of the breach by Subcontractor of any of the terms of this Subcontract, and its failure to correct such breach within three (3) days after receipt of written notice thereof from Contractor, or in the event that a petition under any of the provisions of the Bankruptcy Act of The United States is filed by or against the Subcontractor, or the Subcontractor makes an assignment for the benefit of creditors, or the Subcontractor becomes insolvent or a receiver of his property is appointed or in the event Subcontractor should otherwise become disabled from complying with the provisions hereof, including, without limitation, the stoppage of his work due to a labor dispute involving Subcontractor or otherwise arising out of the subcontract work, then the Contractor, without further notice to the Subcontractor, shall have the right to any or all of the following remedies without prejudice to any other right or remedy he may have under this agreement or by law:

1. Contractor may supply such number of workers and quantity of material, equipment and other facilities as the Contractor deems advisable for the completion of the Subcontract Work, or any part thereof, which Subcontractor has failed to complete or perform after the aforesaid notice, and charge the cost thereof to the Subcontractor, who shall be liable for payment of same;

2. Contractor may contract with one or more additional contractors or subcontractors to complete such portion of the Subcontract Work as Contractor shall determine will be necessary to complete the total Subcontract Work, and charge the cost to the Subcontractor, who shall be liable for payment of same; or

3. Contractor may terminate the subcontract and finish the work by whatever method he may deem expedient either by himself or through other contractors or subcontractors, and charge the cost thereof to the Subcontractor, who shall be liable for payment of the same.

Contractor may deduct all costs incurred by him in the pursuance of any of the above remedies together with Contractor's reasonable overhead and direct job expenses incurred in pursuing such remedy or remedies, including attorney's fees and, at Contractor's discretion, a reasonable profit not to exceed fifteen percent (15%) from any sums due or to become due hereunder. Subcontractor shall be liable and pay to the Contractor any amount such costs exceed the unpaid balance of total subcontract amount set forth in paragraph 3.1 heretofore mentioned.

In the event Contractor exercises any of its available remedies, as set forth herein, Contractor may take possession of and have a lien upon all materials, equipment, tools and machinery at the construction site owned by or in the possession of the Subcontractor for the purpose of completing the work on the Project and securing any amounts which may be due to the Contractor. The Contractor shall have no obligation to protect or insure such materials, equipment, tools or machinery.

In the event Contractor exercises any of its available remedies, as set forth herein, the Subcontractor shall not be entitled to any further payment, if at all, until all of Subcontractor's Work is completed and accepted and any potential claim for delay is resolved.
SUBCONTRACT AGREEMENT
MCI/MDI version 2016-3

It is further specifically agreed that in the event Contractor exercises any of its available remedies, as set forth herein, the Subcontractor shall not be entitled to any further payment, if at all, until the warranty period for the Subcontract Work has fully expired regardless of whether the work has been paid for by the Owner.

SECTION 14: ADDITIONAL PROVISIONS

14.1 Any failure or delay by the Contractor in enforcing the obligations of Subcontractor shall not waive the obligation in the future or the Contractor's right to insist on prompt performance of such obligation in the future. Any obligation placed upon the Subcontractor may be waived or modified only in writing signed by both the parties.

14.2 The subcontract agreement has been executed by the Contractor in the State of Kansas and shall be interpreted and governed by the laws thereof. The Contractor and the Subcontractor, for themselves, their successors, executors, administrators and assigns, hereby agree to the full performance of the covenants of this Subcontract Agreement.

14.3 Notwithstanding any inconsistent provision in the contract documents, all actions, suits or proceedings arising directly or indirectly from this subcontract shall be litigated only in the District Court of Shawnee County, Kansas, and the Subcontractor hereby consents to the jurisdiction of that court. Provided, however, if a claim, action, suit, arbitration or proceeding is brought against the Contractor by the Owner or some other third party in some other jurisdiction or forum, the parties consent to litigation or arbitration of any claims one has against the other in such forum or jurisdiction and in such proceeding to facilitate resolution of all issues involving all parties in one proceeding.

14.4 In the event that provisions of the Prime Contract or Contract Documents do not permit consolidation or joinder with disputes of third parties, such as the Subcontractor, resolution of any dispute between the Subcontractor and the Contractor shall be stayed pending resolution of the dispute between the Contractor and the Owner.

14.5 All words in this Subcontract Agreement shall be deemed to include any number or gender as the context or sense of this Subcontract requires. Although drafted by Contractor, this Subcontract shall in the event of any dispute over its meaning or application, be interpreted fairly and reasonably and neither more strongly for or against either party.

14.6 All notices required under this Subcontract Agreement shall be sent via certified mail return receipt requested to the address set forth in the Subcontract Agreement, via facsimile number listed on the Subcontract Agreement or via hand delivery to the office set forth on the Subcontract Agreement. Verbal notification to Contractor will not satisfy the notice requirements herein. To the extent any notice provision of this Subcontract violates applicable law in that it is too strict or restrictive, the provision shall be automatically modified to the standards mandated by the applicable law and shall not be void.

14.7 In the event one or more of the provisions of this Subcontract Agreement or any application thereof shall be invalid, unenforceable, or illegal, the validity, enforceability and legality of the remaining provisions and any other application thereof shall not in any way be impaired thereby.

14.8 This Subcontract Agreement contains and includes all the entire understanding of the parties. Any oral agreements, prior proposals, understandings, and correspondence are hereby superseded by this Subcontract Agreement. In addition, Subcontractor waives any claim for fraudulent inducement with respect to this Subcontract. This Subcontract may be amended only by an instrument in writing signed by the parties hereto.

14.9 Contractor has no control nor seeks any control over the labor relations policy of Subcontractor; however, Subcontractor agrees that if pickets are established by local unions at the job site, that its employees will either cross those picket lines or will enter the job site through a different entrance. Subcontractor agrees to establish a separate entrance to the job site as directed by Contractor. Failure of Subcontractor to man the job with a sufficient number of skilled workmen during a labor dispute shall not be a defense to Contractor’s remedies under any provision of this Subcontract. Subcontractor agrees that Contractor may take all remedies provided in Articles 4, 7 or 13 of this
Subcontract should Subcontractor delay the Project as the result of a labor dispute of any nature.

14.10 In the event that labor only is furnished by Subcontractor, Subcontractor agrees to use Contractor’s materials without waste and agrees to reimburse Contractor for any material ruined or damaged on account of its negligence or carelessness. Material furnished by Contractor shall be considered as delivered to Subcontractor when placed at the curb line of the building on the job site in which it is to be used or any other place designated by Contractor. Quantities of material used daily shall be reported to Contractor.

14.11 Subcontractor shall neither purchase materials nor incur other debts in Contractor’s name without Contractor’s prior written authorization.

14.12 Subcontractor shall not assign or transfer this Subcontract or any part or interest therein, including but not limited to the right to the proceeds therefrom without express written consent from Contractor, such consent to be granted or withheld in Contractor’s sole discretion.

14.13 Unless otherwise provided in a writing signed by the Contractor, all materials needed to perform the Subcontractor’s Work that are shipped to the Project site shall be shipped F.O.B. the Project site. If a carrier requests that the Contractor pay any shipping or delivery costs, the Contractor shall, at its option, be entitled to do so and deduct all amounts paid from the Subcontract Sum.

14.14 Notwithstanding any other provision of this Subcontract, the risk of loss or damage to materials or equipment provided pursuant to this Subcontract, shall remain with the Subcontractor until incorporated into the Subcontractor’s Work. Any damage to materials or equipment during transit or storage shall be the responsibility of the Subcontractor regardless of the manner in which the material or equipment was shipped or who paid the freight or delivery costs.

14.15 The Subcontractor agrees to perform and be responsible for all design and engineering services required by the Subcontract Documents to be performed by the Subcontractor as part of the Subcontract Work. Subcontractor agrees to defend, indemnify and hold harmless the Owner and the Contractor from and against all claims, damages, losses, or expenses, including attorney’s fees, resulting from Subcontractor’s performance or failure to perform such design or engineering services.

14.16 This project is or is not exempt from payment of sales tax.

14.17 All requirements for Contract Closeout are to be met before submission of final Application for Payment or Reduction of Retainage. The Subcontractor will be required to provide all Closeout information in an electronic and hard copy format.

14.18 The McPherson Contractor, Inc. General Front End Requirements shall be considered a part of this agreement. Copies of this document will be made available upon request.

IN WITNESS WHEREOF, we have hereunto set our hands this day and year first above written.

SUBCONTRACTOR:                                  CONTRACTOR:

By:___________________________    By:____________________________
Printed Name

Title:________________________  Title:

Date:___________________________

Date:
GEOTECHNICAL EXPLORATION
AND
FOUNDATION RECOMMENDATIONS

SW 34th Street and SW Fairlawn Road
Topeka, Kansas
CFS Project No. 17-1028

Prepared For
Wanamaker Twenty-Nine, LC
3501 Fairlawn Road
Topeka, Kansas 66614

June 16, 2017

Prepared by:
Cook, Flatt & Strobel Engineers, P.A.
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103
913.627.9040
SYNOPSIS

An exploration and evaluation of the subsurface conditions have been made on the site of the proposed office building located at SW 34th Street and SW Fairlawn Road in Topeka, Kansas.

Test borings have been drilled and selected soil samples submitted for laboratory tests. The data has been carefully analyzed in light of the project information provided by Wanamaker Twenty-Nine, L.C.

The results of the exploration and analysis indicate that conventional spread and continuous wall footings appear to be a suitable type of foundation for the support of the proposed structure.

Difficulty may be encountered when working with the highly plastic clays and silts found on the site. Moisture conditioning and protection from runoff will be very important. CFS recommends treating the dark gray CH/MH soils with cement or fly ash, or removing them from the site, during earthwork operations.

Detailed analysis of subsurface conditions, any alternate foundation types, and pertinent design recommendations are included herein.

Groundwater conditions are not expected to cause any major difficulties. These conditions will be further discussed in the report.
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Appendix A: Figures

  Figure 1 – Site Location Plan
  Figure 2 – Boring Location Plan

Appendix B: Boring Logs

Appendix C: Laboratory Test Results

Appendix D: Fly Ash and Cement Specifications
1.0 Introduction

1.1 Authorization

This report presents the results of a geotechnical exploration and foundation analysis for the proposed office building at 34th and Fairlawn, conducted for Wanamaker Twenty-Nine, L.C. The work for this project was performed in accordance with our Proposal dated May 17, 2017. Authorization to perform this exploration and analysis was received in the form of a signed copy of that proposal.

1.2 Purpose

The purpose of this exploration was to evaluate the soil and groundwater conditions at the site and to recommend a type and depth of foundation system suitable for the proposed structure as well as to provide criteria for the Architects and Design Engineers to use in preparing the foundation design. Also included were site preparation, earthwork, and pavement design recommendations.

1.3 Scope

The scope of the exploration and analysis included a reconnaissance of the immediate site, the subsurface exploration, field and laboratory testing, and an engineering analysis and evaluation of the foundation materials.

The scope of services did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statement in this report or on the boring logs regarding odors, colors, or unusual or suspicious items or conditions is strictly for the information of the client.

1.4 General

The general subsurface conditions used in the analysis were based upon interpolation of the subsurface data between the borings. There is a possibility that varying conditions may be encountered between boring locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the Geotechnical Engineer.
The recommendations submitted for the proposed structure are based on the available soil information and the preliminary design details. Any revision in the plans for the proposed structure, from those described in this report, should be brought to the attention of the Geotechnical Engineer to determine if changes in the foundation recommendations are required.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, and professional advice contained herein have been presented after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

After the plans and specifications are complete, it is recommended that the Geotechnical Engineer be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations are properly interpreted and implemented.

### 2.0 Project Description

It is understood that this project consists of a two-story, wood-framed building with approximately 3,750 square-feet per floor and walk-outs on both levels. Foundation loads for the new building were not known at the time our report was prepared. Based on the building type and anticipated column spacing, we have assumed that the maximum foundation loads will be less than 3 kips per lineal foot (klf) for load bearing walls.

According to information provided by the Project Engineer, it is understood that the finished floor elevations of the new building have tentatively been set at approximately 1015.5 and 1027.5 feet. At this proposed floor level, up to eight (8) feet of new fill may be required to develop finished grades on the east side of the building, and up to six (6) feet in the proposed building area.

Light duty parking lots are planned along the south and east sides of the new building. The parking lots will provide space for 26 automobiles.

There are plans to potentially add a second building to the north of the one being investigated. This expansion may also include the addition of 42 more parking spaces. This second site was not within the scope of this investigation.

#### 2.1 Site Location

The site is located southwest of the intersection of SW Fairlawn Road and SW 34th Street in Topeka, Kansas. The address for the site in the Shawnee County GIS system is listed as 3497 SW Fairlawn Road, Topeka, KS 66614. It is located in the southeast quarter-section of Section 16, Township 12S, Range 15E, as described in the PLSS.

A Site Location Map is available as Figure 1 in Appendix A.

#### 2.2 Topography

The site currently slopes down towards the west and north. Based on the existing contours shown on the preliminary site plan that was provided to CFS, it is anticipated that up to eight (8) feet of fill may be required just east of the new building. Due to the walk-out lower level, it is anticipated that the building area will need to be cut approximately five (5) to six (6) feet for the lower slab.
At the time the borings were performed, the site was a vacant, grass-covered tract, with the exception of a cell phone tower in the southwest corner of the site. The existing ground surface sloped down towards the west and north at a grade of about three (3) to nine (9) percent. There was only two (2) to three (3) feet of elevation change across the proposed building area.

2.3 Site Geology

Shawnee County is located in the Central Lowland province of the Interior Plains. The region is underlain by rock units of the Pennsylvanian System, Virgilian Series (Wabaunsee Group) in the Time Stratigraphic Unit age classification.

According to the Kansas Geological Survey this site lays over the Scranton Shale Formation of the Wabaunsee Group, Virgilian Series. The Scranton Shale Formation generally consists of three (3) main layers of shale (White Cloud Shale, Cedar Vale Shale, and Silver Lake Shale), with thin limestone layers separating them.

3.0 Site Exploration

3.1 Scope

The field exploration to evaluate the engineering characteristics of the foundation materials included a reconnaissance of the project site, drilling the test borings, performing standard penetration tests, and recovering split barrel samples. The depth to groundwater, if encountered, was recorded in each test boring during drilling.

Seven (7) test borings were drilled to depths ranging from five (5) to 20 feet below the existing ground surface (bgs). They were made in the locations determined by Cook, Flatt & Strobel Engineers. The field tests were located in the field by CFS Engineers using normal taping procedures and available landmarks. The locations are shown on the accompanying Boring Location Plan (Figure 2, Appendix A). The boring locations are presumed to be accurate to within a few yards.

After completion of the field testing, the excavations were backfilled with the excavated soil.

3.2 Drilling and Sampling Procedures

A drilling rig equipped with a rotary head was used to drill the test borings. Solid-stem augers were used to advance the holes. Representative samples were obtained employing split-barrel sampling procedures in general accordance with the procedures for “Standard Test Methods for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils” (ASTM D 1586).

All of the samples recovered were identified, classified, and evaluated by the Geotechnical Engineer.

3.3 Field Tests and Measurements

Penetration Tests – During the soil boring procedure, standard penetration tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value of the soil as outlined in the ASTM D1586 test method. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty (30) inches, required to advance the split-barrel sampler one (1) foot into the soil.
The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer.

The number of blows is recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is then obtained by adding the second and third incremental numbers. The results of the standard penetration test are shown on the Boring Logs and indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

**Water Level Measurements** – Water level measurements were taken during the test boring operations. They are noted on the test boring logs presented in Appendix B.

**Ground Surface Elevations** – The elevation of the ground surface shown on each test boring log was estimated by interpolation from a one (1) foot interval topographic map prepared by CFS Engineers and is presumably accurate to within ± four (4) feet.

Boring logs are included in Appendix B. Field logs included visual classification of the materials encountered during drilling, as well as drilling characteristics. Boring logs represent the CFS engineer’s interpretation of the field logs combined with laboratory observations and testing of the samples. The stratification boundaries indicated on the boring logs were based on field observations, an extrapolation of information obtained by examining samples from the borings and comparisons of soils and/or bedrock types with similar engineering characteristic. Boundary locations are approximate, and the transitions between soil and bedrock types may be gradual rather than clearly defined.

### 3.4 Laboratory Testing Program

In addition to the field exploration, a supplemental laboratory testing program was conducted to evaluate additional engineering characteristics of the on-site soils and rock necessary in analyzing the behavior of the foundation systems for the proposed structure.

The laboratory testing program included the following tests:

- Supplementary visual classification (ASTM D2488) of all samples
- Penetrometer tests of all samples
- Water content (ASTM D2216) of all samples
- Atterberg limit tests (ASTM D4318) on selected samples

All phases of the laboratory testing program were conducted in general accordance with applicable ASTM specifications. The results of these tests can be found on the Boring Logs (Appendix B) and in the Laboratory Test Results (Appendix C).

### 3.5 Subsurface Conditions

#### 3.5.1 General

The types of foundation bearing materials encountered in the test borings have been classified according to the Unified Soil Classification System (USCS). They are described on the Boring Logs. The results of
the field tests, water level observations, and laboratory tests are presented on the Boring Logs (Appendix B).

### 3.5.2 Groundwater Conditions

Groundwater was encountered in B-1 at 11 feet below ground surface (bgs) during drilling. This level dropped to 15 feet bgs after the drilling was completed. B-2 encountered ground water at approximately 17 feet bgs.

### 3.5.3 Refusal Materials

Refusal was not encountered in the test borings.

### 3.6 Testing Results

Laboratory tests performed on representative samples of the site’s soils indicated moisture contents in the range of 14.8 to 35.8 percent.

The Standard Penetration Test (SPT) was also used to evaluate the consistency of the in-situ materials. The N-values for the site’s materials were found to range from 7 to 30 blows/foot, with an average of 14.3 blows/foot.

Atterberg limits tests were ran on three (3) of the samples collected from the SPT sampler. The Liquid Limits ranged between 50 and 59. The Plastic Limits were found to range from 22 to 30 giving the samples Plasticity Indexes ranging between 27 and 35. The cohesive soils were classified using the USCS as CH based on these results. CFS classified the dark gray silty sample as CH-MH due to its location on the boundary between CH and MH.

Representative samples of the soils were placed in sample jars and bags. They are now stored in the laboratory for further analysis if desired. Unless a request to the contrary is received, all samples will be disposed of sixty (60) days from the issuance date of this report.

### 4.0 Geotechnical Discussion and Recommendations

#### 4.1 Primary Geotechnical Concerns

The primary geotechnical concern for this site is the difficulty in working with the fat clay and silt soils. High plasticity Silts (MH) are not common in this region, and may require more moisture conditioning than contractors are used to. They are also susceptible to losing strength when wetted, making proper runoff control critical. To make these soils easier to compact they may be treated with fly-ash (at 15% by weight) or cement (5% by weight) during compaction to provide a much stronger and more moisture tolerable surface.

#### 4.2 Foundation Discussion

**Subsurface Materials** – The bearing capacity of the subsurface materials was evaluated from the results of the field tests. These test results indicate that the soils have moderate strength and are uniform in thickness.
General – The foundation types considered for the proposed structure include conventional spread and continuous wall footings, a raft or mat, a grid type beam and slab, available types of piles, drilled piers/caissons, and augured cast-in-place piles.

Conventional Spread and Continuous Wall Footings – Conventional spread and continuous wall footings are generally, most economical when the existing soil conditions allow them to be founded at shallow depths. With economy, however, comes a risk of differential settlement that may not be reliably predicted. If elimination of settlement is essential, other, more expensive foundations may be required.

Considering the soil conditions on this site and the proposed loads of the structure, it appears that conventional spread and continuous wall footings will be a suitable foundation system.

Post Tensioned Slab – A post tension slab foundations used most advantageously to distribute comparatively heavy structural loads onto a relatively weak or expansive foundation material.

The foundation soils at this site and the anticipated loads do not appear to warrant this distribution of loads. However the use of post tensioned slab would reduce the requirement for over-excavation of the expansive soils as described in Section 5.3 of this report. More information can be provided if desired.

Raft/Mat – A raft or mat foundation is used most advantageously to distribute comparatively heavy structural loads onto a relatively weak foundation material.

However, the foundation soils at this site and the anticipated loads do not appear to warrant this distribution of loads. Economically, a raft foundation does not appear to be practical for this structure.

Piling/Drilled Piers – Several types of piling or drilled piers could be used to support the proposed structure. However, deep foundation systems do not appear required for the proposed structure when the engineering characteristics of the foundation materials are considered with regard to the anticipated design loads unless elimination of settlement noted in 4.3.1.3 below is desired.

4.3 Foundation Recommendations

4.3.1 Conventional Spread Footings

Conventional spread footings and continuous wall footings are recommended for support of the proposed structure. The conventional spread footings and continuous wall footings should be designed as follows when founded on stiff clay soils:

Table 1: Conventional Footing Bearing Capacity

<table>
<thead>
<tr>
<th>Foundation Type</th>
<th>Net Allowable Soil Bearing</th>
<th>Minimum Footing Width</th>
<th>Min. Depth Below Finish Grade for Exterior Ftg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spread footings</td>
<td>2,500 psf</td>
<td>24 inches</td>
<td>36 inches</td>
</tr>
<tr>
<td>Continuous wall footings</td>
<td>2,500 psf</td>
<td>16 inches</td>
<td>36 inches</td>
</tr>
<tr>
<td></td>
<td>1,500 psf</td>
<td>12 inches</td>
<td>36 inches</td>
</tr>
</tbody>
</table>
1. Footings should be suitably reinforced to reduce the effects of differential movement that may occur due to variations in the properties of the supporting soils. Top and bottom steel is recommended for continuous wall footings to reduce differential settlement due to possible varying bearing capacities of the soils.

2. A representative of the Geotechnical Engineer should test the soils in the footing excavations to verify the design soils bearing pressure. If undercutting of any footing is required to reach design bearing capacity backfill of the undercut footing should be done with a closed grade stone (such as KDOT AB-3) or lean concrete. If compacted structural soil fill is used to back fill the excavation, widening of the excavation one-half (1/2) the depth of the excavation on either side should be performed. All backfill should be compacted to at least 95% of ASTM D-698 density at an appropriate optimum moisture content for the soil type.

3. Every effort should be made to keep the footing excavations dry as the soils will tend to soften when exposed to free water. Footing bottoms should be free of loose soil and concrete should be placed as soon as possible to prevent drying of the foundation soils.

4. Total settlement for the bearing value provided below should not exceed one (1) inch. Differential settlement over fifty (50) feet is estimated to be one-half (1/2) inch or less.

### 4.4 Lateral Earth Pressures

Lateral earth pressures are determined by multiplying the vertical applied pressure by the appropriate lateral earth pressure coefficient. If the walls are rigidly attached to the structure and not free to rotate or deflect at the top (such as basement walls), CFS recommends designing the walls for the at-rest earth pressure coefficient. Walls that are permitted to rotate and deflect at the top (such as retaining walls) can be designed for the active lateral earth pressure condition. Horizontal loads acting on shallow foundations are resisted by friction along the foundation base and by passive pressure against the footing face that is perpendicular to the line of applied force.

It is recommended that all retaining walls be backfilled with open graded stone (such as No. 57) from two (2) feet behind the wall rising at a 45 degree angle to within two (2) feet of the ground surface. The use of stone to backfill behind the walls will expedite construction, reduce potential settlement, and lower the pressure induced on the wall from the backfill thus potentially reducing the thickness of the walls.

<table>
<thead>
<tr>
<th></th>
<th>Active</th>
<th>Passive</th>
<th>At-Rest</th>
<th>Allowable Base Friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-graded crushed limestone</td>
<td>0.27</td>
<td>3.69</td>
<td>0.43</td>
<td>0.47</td>
</tr>
<tr>
<td>In-situ lean clay soils</td>
<td>0.40</td>
<td>2.5</td>
<td>0.68</td>
<td>0.32</td>
</tr>
<tr>
<td>In-situ fat clay soils</td>
<td>0.49</td>
<td>2.04</td>
<td>0.66</td>
<td>0.24</td>
</tr>
<tr>
<td>Lean clay – conditioned and compacted</td>
<td>0.32</td>
<td>3.12</td>
<td>0.48</td>
<td>0.35</td>
</tr>
<tr>
<td>Fat clay – conditioned and compacted</td>
<td>0.45</td>
<td>2.2</td>
<td>0.63</td>
<td>0.27</td>
</tr>
</tbody>
</table>
These earth pressure coefficients do not include the effect of surcharge loads, hydrostatic loading, or a sloping backfill. Nor do they incorporate a factor of safety. Also, these earth pressure coefficients do not account for high lateral pressures that may result from volume changes when expansive clay soils are used as backfill behind walls with unbalanced fill depths. In addition, any disturbed soils that are relied upon to provide some level of passive resistance should be placed in lifts not exceeding six (6) inches in thickness and compacted to a minimum density of 95 percent of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within +3 percent of the optimum moisture content. It is recommended that a representative of CFS should verify the compaction of any such materials relied upon to provide passive pressure.

The actual earth pressure on the walls will vary according to material types and backfill materials used and how the backfill is compacted. If the backfill conditions are different than the ones used above, CFS should be notified so the recommendations can be modified. The buildup of water behind a wall will increase the lateral pressure imposed on below-grade walls. Adequate drainage should be provided behind any below grade walls as described in this report. The walls should also be designed for appropriate surcharge pressures such as adjacent traffic, structures, and construction equipment.

Backfill of the below-grade walls may consist of well graded stone or on-site clay soils compacted to at least 95% of optimum dry density at a moisture content within 3% of optimum. We advise performing field density tests on the backfill to monitor compliance with the recommendations provided. Care should be exercised during the backfilling operation to prevent overstressing and damaging the walls. Heavy compactors and grading equipment should not be allowed to operate within 5 to 10 feet of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

### 4.5 Engineering Analysis – Seismic

The Seismic Site Class was determined by the General Procedure in accordance with Section 1613.3.2 of the 2012 International Building Code. The soil properties were evaluated for the top 100 feet of the profile. The seismic properties of the soil were interpolated from the standard penetration test values. A Seismic Site Class “C” was determined for this site. In addition, there is no significant risk of liquefaction or mass movement of the on-site soils due to a seismic event.

Higher soil shear wave velocities, and therefore a better Site Class, are sometimes obtained by direct testing of the subsurface materials. However, the cost of completing a site-specific seismic study would likely outweigh the benefits of having such a study.

### 5.0 Earthwork Discussion and Recommendations

#### 5.1 Discussion – Earthwork

**Groundwater** – Groundwater that was encountered in Borings B-1 and B-2 is not expected to require special dewatering methods, however it may be higher during construction depending on weather conditions. The water was encountered at depths of approximately 6-12 feet below the lower level finished grade. Normal seasonal weather conditions should be anticipated and planned for during earthwork.
**Suitable Fill Material** – All structural fill should be free of debris and defined by ASTM 2487 as CH, CL, ML, GW, GP, SM, SW, SC, and SP. The onsite soils do meet this requirement; however CH and MH soils should NOT be used as structural fill within two (2) feet of the finished grade under the building slab and ten (10) feet outside the building perimeter.

Depending upon the amount of weather in months preceding construction, it may be necessary to moisture adjust the soils prior to their being able to be properly compacted.

**Unsuitable Fill Material** – The topsoil contains organic material and is unsuitable for use as structural fill. Unsuitable materials are those defined by ASTM 2487 as MH, OL, OH, and PT.

**Retaining Walls, Utility Trenches and Paved Areas** – The boring locations were limited to the building and pavement areas. Exploration of the subsurface materials in the area of retaining walls and utility trenches were not included in the scope of work. Varying subsurface conditions may be encountered in those areas.

### 5.2 Recommendations - Earthwork

1. The grass and topsoil should be stripped from all structural areas and be stockpiled for later use in landscape areas or be discarded.

2. The surface of the site should be proof compacted to detect and compact any localized soft areas at the surface of the site.

3. Structural fill materials should be free of organic matter. Moisture contents should be within 0% and +4% of the optimum for soils with a liquid limit of greater than 40, and +/-3% of the optimum for soils with a liquid limit of less than 40. Maximum dry density and optimum moisture content should be determined by the Standard Proctor test (ASTM D 698).

4. Fill should be placed in six (6) inch lifts (compacted thickness) in mass fill areas and as needed to obtain proper compaction in utility trenches and behind walls.

5. Structural fill should extend a minimum of five (5) feet outside the building line. The top of slopes should also be a minimum of ten (10) feet outside the building line.

6. The site should be graded such that positive drainage (normally 2% minimum) is provided away from the building.

7. A representative of the Geotechnical Engineer should monitor filling operations. A sufficient number of density tests should be taken to verify that the specified compaction is obtained. See Table below for required testing frequency.

8. The upper 24 inches of material beneath any slab-on-grade should consist of low volume change (LVC) material as defined in Section 5.3 below. The onsite soils do not qualify as LVC.
Table 3: Density Testing Frequency

<table>
<thead>
<tr>
<th>Location or Area</th>
<th>Standard Proctor Density (ASTM D 698)</th>
<th>Testing Frequency One per lift per …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures and Walkways</td>
<td>95%</td>
<td>20,000 sf</td>
</tr>
<tr>
<td>Retaining Walls</td>
<td>95%</td>
<td>1,000 sf</td>
</tr>
<tr>
<td>Trenches</td>
<td>95%</td>
<td>150 lf</td>
</tr>
<tr>
<td>Lawn or Unimproved Areas</td>
<td>92%</td>
<td>20,000 sf</td>
</tr>
<tr>
<td>Building and Pavement Subgrades</td>
<td>95%</td>
<td>10,000 sf</td>
</tr>
<tr>
<td>Out-Parcels</td>
<td>95%</td>
<td>20,000 sf</td>
</tr>
</tbody>
</table>

5.3 Recommendations – Slab-on-Grade

After completion of earthwork in accordance with Section 5.2 above, a minimum 6-inch thick mat of well-graded crushed stone—equivalent to KDOT AB-3, MoDOT Type 5, or ASTM C-33 No. 57 stone (1”minus)—should be placed beneath the floor slab. The granular layer will ease construction, provide capillary break, aid in drainage, and reduce slab curling due to differential cure. Prior to placement of concrete, the granular material should be compacted to a minimum dry density of 95 percent of the maximum dry density as determined by ASTM D 698 at moisture contents within ±3 percent of the optimum moisture content.

Proof-rolling and/or re-compaction of the subgrade soils should be accomplished just prior to placement of the base stone to identify soft/unstable soils and disturbance from utility excavations. Unsuitable soils should be removed and replaced with engineered controlled fill. Moisture conditioning of the upper soils may also be required prior to placement of the base stone and slab on grade. It is very important that the moisture content of the subgrade soils be maintained until concrete is placed. Rutted subgrade should be repaired prior to placement of base rock to avoid a potential water trap and subsequent subgrade heave.

The upper eighteen (18) inches below the six (6) inch (minimum) stone layer outlined above should consist of low volume change (LVC) material. Including the stone layer, there should be a minimum of 24 inches of LVC below all slabs-on-grade.

Low Volume Change (LVC) material is defined as soils or stone with liquid limits less than 45 and a plasticity index below 25. The on-site soils do not meet these requirements. Well graded stone such as KDOT AB-3 or limestone screenings may be used as LVC material. It is not recommended to use limestone screenings in the winter months, as damage may occur from the screenings freezing

As a substitute to the placement of LVC beneath the slab-on-grade, the on-site clays can be mixed and compacted with 13% to 15% by weight class “C” fly-ash for a minimum depth of eighteen (18) inches provided the minimum layer of stone is also provided. Five percent (5%) by weight Type 1/2 Portland cement for a minimum depth of twelve (12) inches may be substituted for the eighteen (18) inches of fly ash treated or LVC soil with a minimum six (6) inch layer of stone. Fly-ash should not be used during the winter months, or during any time where the ambient temperature may drop below 40°F before curing of the fly-ash can occur. See Appendix D for guidelines related to fly-ash stabilization of soils.

The LVC material or soil treatment should extend ten (10) feet outside the building walls plus all sidewalks and entries to the building.
Every floor slab-on-ground (on-grade or below-grade) should have a vapor retarder under the concrete that meets the requirements of ASTM E1745, or E1993, installed in accordance with the recommendations of ACI 302.2R. The slab designer should refer to ACI 302 and/or ACI 360 for procedures regarding the use and placement of a vapor retarder.

To reduce the effects of differential movement, slabs-on-grade should not be rigidly connected to columns, walls, or foundations unless it is designed to withstand the additional resultant forces. Floor slabs should not extend beneath exterior doors or over foundation grade beams, unless saw cut at the beam after construction. Expansion joints may be used to allow unrestrained vertical movement of the slabs. The floor slabs should be designed to have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage. We suggest joints be provided on a minimum spacing of twelve (12) feet on center. For additional recommendations refer to the ACI Design Manual. The requirements for the slab reinforcement should be established by the designer based on experience and the intended slab use.

For prepared subgrade as recommended and placed on properly compacted LVC soil and six (6) inch stone base, a modulus of subgrade reaction, k value, of 100 (psi/in) may be used for slab design. If stone is used in the upper 24 inches for the LVC, a modulus of subgrade reaction, k value, of 200 (psi/in) may be used for slab design.

5.4 Excavations and Trenches

All temporary slopes and excavations should conform to Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry (29 CFR Part 1926, Subpart P). Excavations at this site are expected to be made in “Type B” clayey soil. Soil types should be verified in the field by a competent individual.

All excavations should be kept dry during subgrade preparation. Storm water runoff should be controlled and removed to prevent severe erosion of the subgrade and eliminate free standing water. Subgrade that has been rendered unsuitable from erosion or excessive wetting should be removed and replaced with controlled fill.

Trenches should be excavated so that pipes and culverts can be laid straight at uniform grade between the terminal elevations. Trench width should provide adequate working space and sidewall clearances. Trench subgrade should be removed and replaced with controlled fill if found to be wet, soft, loose, or frozen. Trench sub-grades should be compacted above 95% of the maximum dry density in accordance with ASTM D 698 at moisture contents between -3% to +3% of the optimum moisture content.

Granular bedding materials for pipes, such as well-graded sand or gravel, may be used provided that the bottom of the trench is graded so that water flows away from structure

Bedding material should be graded to provide a continuous support beneath all points of the pipe and joints. Embedment material should be deposited and compacted uniformly and simultaneous on each side of the pipe to prevent lateral displacement. Compacted control fill material will be required for the full depth of the trench above the embedment material except in area landscape area with the compaction may be reduced to 90% Standard Proctor ASTM D 698. No backfill should be deposited or compacted in standing water.
Precautions should be taken by the contractor to avoid undermining the newly constructed foundations. Shoring and excavations supports should be designed to account for the existing structure loads.

Permanent slopes greater than 3 horizontal to 1 vertical should not be used.

5.5 Drainage

The site should be graded so that surface water flows away from the building. Where sidewalks or paving do not immediately adjoin the structure, protective slopes of at least 5% for a minimum of 10 feet from the perimeter walls are recommended. Roof drains and downpours should also be directed away from the building. Open-graded stone is not recommended for use under sidewalks unless the stone is adequately drained to prevent collection of water under the walks.

The sites should also be graded to avoid water flows, concentrations, or pools behind retaining walls. If swales are designed at the top of the walls, proper line and slope should be considered to avoid any flow down behind walls. Special attention is needed for sources of storm water from building roofs, gutter downspouts, and paved areas draining to one point.

Perforated plastic pipes should be placed on the backfilled side of the walls near the bottom and daylighted. Six inches of open-graded crushed rock wrapped with geo-textile fabric should be placed behind the walls up to a depth of two feet below the finished grade. As an alternative to the open-graded crushed rock, a manufactured geo-composite sheet drain such as Mirafi G100N, Contech C-Drain, or equivalent, may be used in conjunction with the perforated pipe.

5.6 Landscaping

Landscaping and irrigation should be limited adjacent to buildings and pavements to reduce the potential for large moisture changes. Trees and large bushes can develop intricate root systems that can draw moisture from the subgrade, resulting in shrinkage of the bearing material during dry periods of the year. Desiccation of bearing material below foundations may result in foundation settlement.

Landscaped areas near pavements and sidewalks should include a drainage system that prevents over saturation of the subgrade beneath asphalt and concrete surfaces. Drainage systems in irrigation areas should be incorporated into the storm drain system.

6.0 Pavement Recommendations

The American Association of State Highway and Transportation Officials (AASHTO) methods for design of flexible and rigid pavements were adopted in our design analyses. The light duty pavement design for the parking lots was based on the assumed traffic load of 2,000 ESAL’s per year for 20 years and 10,000 ESAL’s per year for heavy duty pavement.

The pavement subgrade is assumed to be on-site soils consisting of moderate to high plasticity clays. It is recommended that the highly plastic silt (MH) be removed or treated to a depth of two (2) feet under the pavements. The assumed CBR value for the clayey soil that has been used in our design is 3.0. The use and placement of Tensar grid should be in accordance with manufactures specifications.

The performance of pavements is greatly dependent upon proper drainage. Proper sloping of the pavement at ¼ inch per foot or more should be provided.
6.1 Recommended Pavement Thickness

The pavement sections presented below are considered typical and minimum for the report basis parameters. The client should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life. The pavement area subgrade consists of a moisture sensitive soil; yearly maintenance of the pavement will increase the pavement life.

CFS’s preferred asphalt option is option 1 or 1A. Due to the moisture sensitivity of the soils and the increase in ESALs, the use of grid provides an increase safety factor from failure. For Light Duty, Option One has ESAL=63,000 and SN=2.83 and Option 3 ESAL=34,000 and SN=2.48. Similarly for Heavy Duty, Option One ESAL=374,000 and SN=3.57 and Option 3 is ESAL=220,000 and SN=3.30. Consideration should also be given to increasing the pavement thickness in the front third of the parking stalls where most of the customers will park.

In areas that will experience heavy parking volumes (typically those near to the building), an increase of one (1) inch of base is recommended (Option 1A). In these areas, the use of a grid provides the greatest benefit. As the pavement depresses due to consolidation, stripping, or densification of the subgrade with time and automobile wheel loads, water starts to stand in the depression. As is stands it will eventually reach the subgrade and weaken the soils. The use of the grid helps reduce the wheel load depressions.

The use of concrete pavement is also recommended for these soils.

The soils expected beneath the pavement are highly plastic clays and silts. Since these clays tend to expand and contract with changes in moisture and weather conditions, the on-site clays can be mixed and compacted with 13% to 15% by weight class “C” fly-ash or 5% by weight Portland Type 1/2 Cement for a depth of nine (9) inches to increase the life of the pavement.

Table 4: Light Duty Pavement Thicknesses (Parking lots)

<table>
<thead>
<tr>
<th>Asphalt Pavement</th>
<th>Option 1</th>
<th>Option 1A</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>APWA Type 3-01 AC Surface</td>
<td>3.0”</td>
<td>2.0”</td>
<td>2.0”</td>
<td>2.0”</td>
<td>---</td>
</tr>
<tr>
<td>APWA Type 1-01 AC Base</td>
<td>---</td>
<td>---</td>
<td>4.0”</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>APWA Type 2-01 AC Base</td>
<td>---</td>
<td>2.0”</td>
<td>---</td>
<td>2.0”</td>
<td>---</td>
</tr>
<tr>
<td>Tensar Triax TX 5 Geogrid</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Concrete</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>5.0”</td>
</tr>
<tr>
<td>Gravel Base (MoDOT Type 5, KDOT AB-3, or equivalent)</td>
<td>6.0”</td>
<td>6.0”</td>
<td>---</td>
<td>6.0”</td>
<td>4.0”</td>
</tr>
</tbody>
</table>
### Table 5: Heavy Duty Pavement Thicknesses (Truck areas and drives)

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>APWA Type 3-01 AC Surface</td>
<td>2.0”</td>
<td>2.0”</td>
<td>2.0”</td>
<td>---</td>
</tr>
<tr>
<td>APWA Type 1-01 AC Base</td>
<td>---</td>
<td>6.0”</td>
<td>4.0”</td>
<td>---</td>
</tr>
<tr>
<td>APWA Type 2-01 AC Base</td>
<td>3.0”</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Tensar Triax TX 5 Geogrid</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Concrete</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>7.0”</td>
</tr>
<tr>
<td>Gravel Base</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MoDOT Type 5, KDOT AB-3, or equivalent)</td>
<td>6.0”</td>
<td>---</td>
<td>6.0”</td>
<td>4.0”</td>
</tr>
</tbody>
</table>

Note: If base is to be placed in the fall and surface in the spring, then APWA Type 2-01 is recommended to improve performance of base due to lower permeability.

### 6.2 Asphalt Pavement Construction

The granular base course should be built at least 2 feet wider than the pavement on each side to support the tracks of the slip form paver. This extra width is structurally beneficial for wheel loads applied at pavement edge.

Asphalt cement (bitumen) used in the manufacture of asphalt pavement should conform to the Performance Grading system. In the project area, the provincial grade asphalt binder course is PG 64-22. The asphaltic mix for conventional roadway should be designed for 4% air voids. During production, the voids can be expected to vary ±1% of the design value of 4%. Under these conditions, the minimum allowable VMA for base and surface course shall be 12% and 14%, respectively.

Immediately after spreading, each course of the pavement mixture should be compacted by rolling. The initial or “breakdown” rolling shall be accomplished with a steel-wheeled vibratory roller. The motion of the roller should be slow enough at all times to avoid displacement of the hot mixture. The surface of the mixture after compaction should be smooth and true to established section and grade. The completed asphalt concrete paving should have a density equal to or greater than 95% for the base and 96% for the surface of theoretical density.

All asphaltic concrete mix designs and Marshall Characteristics should be submitted to our office and reviewed in order to determine if they are consistent with the recommendations given in this report. All materials to be employed and field operations required in connection with the pavement reconstruction should follow requirements and procedural details as per APWA 2001. In addition, representative of CFS should observe and monitor the pavement construction to assure satisfactory compliance with our engineering recommendations.

### 6.3 Concrete Pavement Construction

The pavement on this site will be subjected to freeze-thaw cycles. Sufficient air entrainment in the range of 6% to 8% is required to provide freeze-thaw durability in the concrete. Concrete with a 28-day specified compressive strength of 4,000 psi is recommended. The concrete mix should contain at least 564 pounds of concrete per cubic yard. A mixture with a maximum slump of 4 inch +/- 1inch is acceptable. If a water-reducing admixture is specified, slump can be higher. For better performance and
crack control, synthetic fiber reinforcement such as Fibermesh® 300 is recommended for the concrete instead of welded wire mesh. Add synthetic fiber reinforcement to concrete mixture in accordance with manufacturer’s instructions.

### 6.4 Pavement Subgrade Preparation

Prior to placement of granular base or asphalt, proof roll and re-compact the exposed surfaces up to a minimum lateral distance of two (2) feet outside the pavement. Any localized soft, wet, or loose areas identified during the proof rolling should be repaired prior to paving. Fill material should be placed in loose lifts up to a maximum of eight (8) inches in thickness and compacted to at least 95% of the maximum dry density in accordance with ASTM D698 at moisture contents outlined in the Earthwork section. Construction traffic, including foot traffic, should be minimized to prevent unnecessary disturbance of the pavement subgrade. Disturbed areas, as verified by CFS’s geotechnical engineer, should be removed and replaced with properly compacted material.

The granular base should be placed in loose lifts up to a maximum of twelve (12) inches in thickness and compacted to at least 98% of the maximum dry density in accordance with ASTM D698.

If open graded stone is used under the pavement, the pavement subgrade should be graded to provide positive drainage of the granular base section. Provision should be made to provide drainage into the storm water system. The use of a granular blanket drain near storm water inlets that provides weep holes from the drain to the inlets is recommended.

### 7.0 General Comments

When the plans and specifications are complete, or if significant changes are made in the character or location of the proposed structure, a consultation should be arranged to review the changes with respect to the prevailing soil conditions. At that time it may be necessary to submit supplementary recommendations.

It is recommended that the services of Cook, Flatt & Strobel Engineers be engaged to test and evaluate the compaction of any additional fill materials and to test and evaluate the bearing value of the soils in the footing excavations.

Respectfully submitted,

COOK, FLATT & STROBEL ENGINEERS, P.A.

[Signatures]

William J. Stafford, P.E.
Senior Geotechnical Engineer

Justin L. Clay, P.E.
Project Engineer
Appendix A: Figures
Figure 1. Site Location Map
34th and Fairlawn
Topeka, KS

Drawn By: JLC
Project #: 17-5133
Figure 2. Boring Location Map
34th and Fairlawn
Topeka, KS

Drawn By: JLC
Project #: 17-5133
Appendix B: Boring Logs
### BORING NUMBER B-1

**PROJECT NAME:** 34th and Fairlawn  
**PROJECT LOCATION:** Topeka, Kansas  

**DATE STARTED:** 6/5/17  
**COMPLETED:** 6/5/17  

**GROUND ELEVATION:** 1020.5 ft  
**HOLE SIZE:** 4 in  

**GROUND WATER LEVELS:**  
- **AT TIME OF DRILLING:** 11.00 ft / Elev 1009.50 ft  
- **AT END OF DRILLING:** 15.00 ft / Elev 1005.50 ft  
- **AFTER DRILLING:** ---

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>SAMPLE TYPE NUMBER</th>
<th>RECOVERY %</th>
<th>BLOWS (N VALUE)</th>
<th>TESTS</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
</table>
| 0          | SS 1               | 56         | 4-4-3 (7)      | MC = 18%  
LL = 50  
PL = 22 |            | Brown, moist, firm, lean CLAY, trace organics |
| 5.5        | SS 2               | 100        | 6-6-12 (18)    | PP = 2.5 tsf  
MC = 23% |            | Brown and gray, moist, stiff to very stiff, fat CLAY (CH), trace sand |
| 10.0       | SS 3               | 100        | 6-7-8 (15)     | PP = 2.25 tsf  
MC = 28% |            | Gray-brown, dark gray, and red-brown, moist, very stiff, fat CLAY (CH), trace gravel |
| 15.0       | SS 4               | 100        | 5-5-6 (11)     | PP = 1.5 tsf  
MC = 29% |            | Gray to dark gray, moist, stiff, fat CLAY/fat SILT (CH-MH), trace fine sand |
| 16.0       | SS 5               | 100        | 4-4-5 (9)      | PP = 1 tsf  
MC = 36% |            | - dark gray |
| 20.0       | SS 6               | 100        | 5-5-9 (14)     | PP = 1.5 tsf  
MC = 18% |            | Brown, gray, and light brown, mottled, moist, stiff, fat CLAY (CH), trace fine sand |

**NOTES:** Boring terminated at 20.0 feet
### Boring Number B-2

**Location:** Topeka, Kansas  
**Client:** Wanamaker Twenty-Nine, LC  
**Project Name:** 34th and Fairlawn  
**Business Name:** Cook, Flatt & Strobel Engineers, PA  
**Project Number:** 17-5133  
**Site:** 34th and Fairlawn

**Ground Elevation:** 1019 ft  
**Hole Size:** 4 in  
**Date Started:** 6/5/17  
**Completed:** 6/5/17  
**Drilling Contractor:** RC Drilling  
**Logged By:** Derek  
**Checked By:** JLC  
**Recovery %:** 89  
**Drilling Method:**  
**Ground Water Levels:**  
**At Time of Drilling:** 17.00 ft / Elev 1002.00 ft  
**At End of Drilling:** ---  
**After Drilling:** ---  
**Date Started:** 6/5/17  
**Completed:** 6/5/17

### Depth (ft)  
<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample Type</th>
<th>Recovery</th>
<th>Blows (N Value)</th>
<th>Tests</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS 1</td>
<td>89</td>
<td>3-5-6</td>
<td>PP = 3/4.5+tsf MC = 23% LL = 57 PL = 30</td>
<td>Brown, moist, firm, lean CLAY, trace organics</td>
</tr>
<tr>
<td>5</td>
<td>SS 2</td>
<td>100</td>
<td>5-5-9</td>
<td>PP = 2 tsf MC = 27%</td>
<td>Dark gray, moist, stiff, fat CLAY/fat SILT (CH-MH)</td>
</tr>
<tr>
<td>12</td>
<td>SS 3</td>
<td>100</td>
<td>4-6-8</td>
<td>PP = 3.5 tsf MC = 26% LL = 59 PL = 24</td>
<td>Gray mottled red-brown, moist, stiff, fat CLAY (CH)</td>
</tr>
<tr>
<td>15</td>
<td>SS 4</td>
<td>100</td>
<td>4-6-8</td>
<td>PP = 2.5 tsf MC = 29%</td>
<td>Brown-gray, moist, stiff, fat CLAY (CH)</td>
</tr>
<tr>
<td>20</td>
<td>SS 5</td>
<td>100</td>
<td>5-7-9</td>
<td>PP = 2 tsf MC = 25%</td>
<td>Light brown, some gray, moist, stiff to very stiff, fat CLAY (CH)</td>
</tr>
<tr>
<td>999</td>
<td>SS 6</td>
<td>89</td>
<td>12-14-16</td>
<td>PP = 3.25 tsf MC = 15%</td>
<td>- with sand, shaley</td>
</tr>
</tbody>
</table>

Boring terminated at 20.0 feet.  

**Ground Water Levels:**  
**At Time of Drilling:** 17.00 ft / Elev 1002.00 ft  
**At End of Drilling:** ---  
**After Drilling:** ---

**Sample Type:**  
- SS 1: 89 3-5-6 (11)  
- SS 2: 100 5-5-9 (14)  
- SS 3: 100 4-6-8 (14)  
- SS 4: 100 4-6-8 (14)  
- SS 5: 100 5-7-9 (16)  
- SS 6: 89 12-14-16 (30)
## Boring Number B-3

### Project Information
- **Client:** Wanamaker Twenty-Nine, LC
- **Project Name:** 34th and Fairlawn
- **Project Number:** 17-5133
- **Project Location:** Topeka, Kansas
- **Date Started:** 6/5/17
- **Completed:** 6/5/17
- **Ground Elevation:** 1017.5 ft
- **Hole Size:** 4 in

### Drilling Method
- **Drilling Contractor:** RC Drilling
- **Logged by:** Derek
- **Checked by:** JLC

### Ground Water Levels:
- **At Time of Drilling:** ---
- **At End of Drilling:** ---
- **After Drilling:** ---

### Notes

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Recovery %</th>
<th>Blows (N Value)</th>
<th>Tests</th>
<th>Graphic Log</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS 1</td>
<td>61</td>
<td>5-5-6 (11)</td>
<td>PP = 2 tsf MC = 32%</td>
<td></td>
<td>Brown, moist, firm, lean CLAY, trace organics</td>
</tr>
<tr>
<td>1016.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SS 2</td>
<td>100</td>
<td>6-7-12 (19)</td>
<td>PP = 3.5 tsf MC = 25%</td>
<td></td>
<td>Dark gray, moist, stiff, fat CLAY/fat SILT (CH-MH)</td>
</tr>
<tr>
<td>1014.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gray mottled red-brown, moist, very stiff, fat CLAY (CH)</td>
</tr>
<tr>
<td>1012.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>Boring terminated at 5.0 feet</td>
</tr>
</tbody>
</table>

Boring terminated at 5.0 feet.
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>SAMPLE TYPE NUMBER</th>
<th>RECOVERY %</th>
<th>BLOWS (N VALUE)</th>
<th>TESTS</th>
<th>GRAPHIC LOG</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
</table>
| 0        | SS 1              | 100        | 4-6-7 (13)      | PP = 1.5 tsf  
MC = 28%     |            | Brown, moist, firm, lean CLAY, trace organics |
| 5        | SS 2              | 100        | 6-6-9 (15)      | PP = 2.75 tsf  
MC = 23%     |            | Light gray, moist, stiff, fat CLAY (CH) |

Boring terminated at 5.0 feet
### Boring Number B-5

**Client:** Wanamaker Twenty-Nine, LC  
**Project Name:** 34th and Fairlawn  
**Project Number:** 17-5133  
**Project Location:** Topeka, Kansas  
**Date Started:** 6/5/17  
**Completed:** 6/5/17  
**Ground Elevation:** 1018 ft  
**Hole Size:** 4 in

**Drilling Method:** RC Drilling  
**Logged By:** Derek  
**Checked By:** JLC

**Drilling Contractor:** RC Drilling  
**Ground Water Levels:**
- At Time of Drilling: ---  
- At End of Drilling: ---  
- After Drilling: ---

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Recovery %</th>
<th>Blows (N Value)</th>
<th>Tests</th>
<th>Graphic Log</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS 1</td>
<td>100</td>
<td>6-8-10 (18)</td>
<td>PP = 2.5 tsf, MC = 30%</td>
<td>1.0</td>
<td>Brown, moist, firm, lean CLAY, trace organics</td>
</tr>
<tr>
<td>5</td>
<td>SS 2</td>
<td>100</td>
<td>6-7-11 (18)</td>
<td>PP = 2.75 tsf, MC = 24%</td>
<td>5.0</td>
<td>Boring terminated at 5.0 feet</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark gray, moist, very stiff, fat CLAY/fat SILT (CH-MH)</td>
</tr>
<tr>
<td>1013.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Light gray, moist, very stiff, fat CLAY (CH)</td>
</tr>
<tr>
<td>1015.0</td>
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<td></td>
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<tr>
<td>1017.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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**Notes:**
- Boring terminated at 5.0 feet
## Project Details

**Client:** Wanamaker Twenty-Nine, LC  
**Project Name:** 34th and Fairlawn  
**Project Number:** 17-5133  
**Project Location:** Topeka, Kansas  
**Date Started:** 6/5/17  
**Date Completed:** 6/5/17  
**Drilling Contractor:** RC Drilling  
**Drilling Method:**  
**Logged By:** Derek  
**Checked By:** JLC  
**Ground Elevation:** 1021.5 ft  
**Ground Water Levels:**  
**Recovery %:**  
**Blows Count (N Value):**  
**Tests:**  
**Material Description:**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>Recovery %</th>
<th>Blows Count (N Value)</th>
<th>Tests</th>
<th>Graphic Log</th>
<th>Material Description</th>
</tr>
</thead>
</table>
| 0          | SS 1        | 100         | 3-6-7 (13)            | PP = 2.75 tsf  
MC = 26%   | 1.0         | Brown, moist, firm, lean CLAY, trace organics |
|            | SS 2        | 100         | 3-6-7 (13)            | PP = 2.25 tsf  
MC = 26%   | 3.0         | Light gray, moist, stiff, fat CLAY (CH) |
|            |             |             |                       |       |            | Light brown, some gray, moist, stiff, fat CLAY (CH), trace sand |
| 5          |             |             |                       |       |            | Boring terminated at 5.0 feet |

**Notes:**
- **Ground Water Levels:**
  - AT TIME OF DRILLING: ---
  - AT END OF DRILLING: ---
  - AFTER DRILLING: ---
<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>SAMPLE TYPE</th>
<th>NUMBER</th>
<th>RECOVERY %</th>
<th>BLOWS/100 LBC</th>
<th>TESTS</th>
<th>GRAPHIC LOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SS</td>
<td>1</td>
<td>83</td>
<td>3-5-6 (11)</td>
<td>PP &gt; 4.5 tsf MC = 17%</td>
<td>Brown, moist, firm, lean CLAY, trace organics</td>
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<tr>
<td>5</td>
<td>SS</td>
<td>2</td>
<td>100</td>
<td>5-5-5 (10)</td>
<td>PP = 2.5 tsf MC = 28%</td>
<td>Medium gray to dark gray, moist, stiff, fat CLAY (CH), shaley</td>
</tr>
</tbody>
</table>

Boring terminated at 5.0 feet
Appendix C: Laboratory Test Results
<table>
<thead>
<tr>
<th>Boring</th>
<th>Sample</th>
<th>Can #</th>
<th>Wt. of Can</th>
<th>Wt can+wet</th>
<th>Wt can+dry</th>
<th>Wt water</th>
<th>Wt dry</th>
<th>M/C (%)</th>
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</thead>
<tbody>
<tr>
<td>B-1</td>
<td>1</td>
<td>2235</td>
<td>7800</td>
<td>6960</td>
<td>840</td>
<td>4725</td>
<td>17.8%</td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>2</td>
<td>2254</td>
<td>7753</td>
<td>6722</td>
<td>1031</td>
<td>4468</td>
<td>23.1%</td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>3</td>
<td>2282</td>
<td>7177</td>
<td>6103</td>
<td>1074</td>
<td>3821</td>
<td>28.1%</td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>4</td>
<td>2246</td>
<td>6599</td>
<td>5610</td>
<td>989</td>
<td>3364</td>
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<tr>
<td>B-1</td>
<td>5</td>
<td>2240</td>
<td>6708</td>
<td>5529</td>
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<td>3289</td>
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<tr>
<td>B-1</td>
<td>6</td>
<td>2286</td>
<td>8355</td>
<td>7425</td>
<td>930</td>
<td>5139</td>
<td>18.1%</td>
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</tr>
<tr>
<td>B-2</td>
<td>1</td>
<td>2275</td>
<td>8794</td>
<td>7565</td>
<td>1229</td>
<td>5290</td>
<td>23.2%</td>
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</tr>
<tr>
<td>B-2</td>
<td>2</td>
<td>2238</td>
<td>7660</td>
<td>6505</td>
<td>1155</td>
<td>4267</td>
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</tr>
<tr>
<td>B-2</td>
<td>3</td>
<td>2274</td>
<td>6651</td>
<td>5742</td>
<td>909</td>
<td>3468</td>
<td>26.2%</td>
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</tr>
<tr>
<td>B-2</td>
<td>4</td>
<td>2255</td>
<td>8247</td>
<td>6885</td>
<td>1362</td>
<td>4630</td>
<td>29.4%</td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>5</td>
<td>2275</td>
<td>7543</td>
<td>6492</td>
<td>1051</td>
<td>4217</td>
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</tr>
<tr>
<td>B-2</td>
<td>6</td>
<td>2247</td>
<td>9439</td>
<td>8511</td>
<td>928</td>
<td>6264</td>
<td>14.8%</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>1</td>
<td>2230</td>
<td>7133</td>
<td>5950</td>
<td>1183</td>
<td>3720</td>
<td>31.8%</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>2</td>
<td>2246</td>
<td>7062</td>
<td>6106</td>
<td>956</td>
<td>3860</td>
<td>24.8%</td>
<td></td>
</tr>
<tr>
<td>B-4</td>
<td>1</td>
<td>2252</td>
<td>6527</td>
<td>5600</td>
<td>927</td>
<td>3348</td>
<td>27.7%</td>
<td></td>
</tr>
<tr>
<td>B-4</td>
<td>2</td>
<td>2253</td>
<td>8593</td>
<td>7394</td>
<td>1199</td>
<td>5141</td>
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<td></td>
</tr>
<tr>
<td>B-5</td>
<td>1</td>
<td>2279</td>
<td>7632</td>
<td>6404</td>
<td>1228</td>
<td>4125</td>
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<tr>
<td>B-5</td>
<td>2</td>
<td>2243</td>
<td>8786</td>
<td>7505</td>
<td>1281</td>
<td>5262</td>
<td>24.3%</td>
<td></td>
</tr>
<tr>
<td>B-6</td>
<td>1</td>
<td>2291</td>
<td>7123</td>
<td>6114</td>
<td>1009</td>
<td>3823</td>
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<td></td>
</tr>
<tr>
<td>B-6</td>
<td>2</td>
<td>2289</td>
<td>8004</td>
<td>6837</td>
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<tr>
<td>B-7</td>
<td>1</td>
<td>2246</td>
<td>10631</td>
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<td>7149</td>
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<tr>
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<td>2</td>
<td>2268</td>
<td>7961</td>
<td>6704</td>
<td>1257</td>
<td>4436</td>
<td>28.3%</td>
<td></td>
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</tbody>
</table>
Liquid Limit, Plastic Limit, & Plasticity Index Test Report

Project: 34th and Fairlawn
Location: Topeka, KS
Tested By: JLC

Job No.: 17-5133
Sample Date: 6/5/2017
Test Date: varies

<table>
<thead>
<tr>
<th>Boring / Sample</th>
<th>Material Description</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 B-2 / SS-3</td>
<td>Brownish-gray CH</td>
<td>59</td>
<td>24</td>
<td>35</td>
<td>CH</td>
</tr>
<tr>
<td>2 B-2 / SS-1</td>
<td>Dark gray CH</td>
<td>57</td>
<td>30</td>
<td>27</td>
<td>CH/MH</td>
</tr>
<tr>
<td>3 B-1 / SS-1</td>
<td>Brown and gray</td>
<td>50</td>
<td>22</td>
<td>28</td>
<td>CH</td>
</tr>
</tbody>
</table>

The graph shows a scatter plot of Liquid Limit (LL) vs. Plasticity Index (PI), with A-Line and H-L Line demarcations. Points 1, 2, and 3 correspond to the samples:

- 1: Brownish-gray CH
- 2: Dark gray CH
- 3: Brown and gray
Appendix D: Fly Ash and Cement Stabilization Specifications
GUIDELINE FOR CEMENT STABILIZATION

Cement stabilized soils should not be constructed without the presence of the geotechnical engineer’s designated representative.

MATERIALS. The material used in stabilization should meet the chemical and physical characteristics of Type I cement ASTM C150. Cement should be kept free from moisture prior to use. Cement stored on the project should be placed in weatherproof bins or buildings with adequate protection from ground dampness.

CONSTRUCTION. The cement stabilized soil should be constructed as described herein. The cement should be spread uniformly across the prepared soil surface at the full application rate by using an agricultural seed spreader, mechanical bulk cement spreader, or other equipment acceptable to the geotechnical engineer’s designated representative.

Cement stabilized material should be placed in approximately horizontal layers not to exceed 8 inches in uncompacted thickness.

Subgrade Preparation. Prior to the beginning of cement treatment, the Contractor should construct the subgrade to an elevation which will provide a subgrade surface conforming to the contract documents upon completion of the cement treatment.

The clay soils should be scarified and pulverized prior to application of the cement. A disc should be used to break up the surface of the material to be stabilized. The mixer or tiller should be used for the full depth of stabilization to break up the clay.

Application. Cement should be spread only on those areas where mixing operations can be completed during the same working day. Mixing and spreading should not be performed during freezing temperatures. When the temperature is below 40 degrees F, the completed stabilized fill should be protected against freezing by a sufficient covering of straw, or by other approved methods. Any areas of completed stabilized subgrade course that are damaged by freezing, rainfall, or other weather conditions should be repaired by the contractor.

The cement should be applied with an approved spreader at an application rate that has been established by the geotechnical engineer, based on laboratory tests with the site soils.

The cement should be distributed at a uniform rate and in such a manner to prevent the scattering of cement by wind. Cement should not be added when wind or weather conditions are not favorable in the opinion of the geotechnical engineer’s designated representative. A motor grader should not be used to spread the cement.

Mixing. The cement, material, and required water should be thoroughly mixed, blended, and pulverized by approved road mixers or by a depth-controlled rotary tiller. Except as provided hereinafter, the Contractor should continue mixing and drying the
soil until all material will pass a 1-inch screen. Scarifying and mixing should be controlled to provide uniform depth within 0.1 ft of the depth specified. If, in the opinion of the geotechnical engineer’s designated representative the material was mixed to a depth greater than indicated on the drawing or as specified herein, additional cement should be added to achieve the desired application rate. If in the opinion of the geotechnical engineer’s designated representative, the material was mixed to a depth less than indicated on the drawing or specified, the material should be remixed.

Moisture content of the mixture should be determined in preparation for final mixing. Moisture in the mixture following final mixing should not be less than the water content determined to be optimum based on dry weight of soil and should not exceed the optimum water content by more than 5 percentage points. Water may be added in increments as large as the equipment will permit; however, such increment of water should be partially incorporated in the mix to avoid concentration of water near the surface. After the last increment of water has been added, mixing should be continued until the water is uniformly distributed throughout the full depth of the mixture, including satisfactory moisture distribution along the edges of the section.

Compaction. The cement stabilized subgrade should be compacted in accordance with the requirements for controlled fill. The compaction should be a minimum of 95% of the maximum density in accordance with ASTM D698 and within +0% to +5% of the optimum moisture content of the cement-stabilized soil.

Not more than 60 minutes should elapse between the time of final mixing and the beginning of compaction.

Protection and Curing. The Contractor should protect the finished treated subgrade from rapid drying, for 7 days, by sprinkling with water as often as is necessary to prevent drying of the surface of the cement-treated subgrade, or by application of the overlying base course. The Contractor should not allow any vehicles or operations which will distort the surface onto the treated surface during the curing period.
GUIDELINE FOR FLY ASH STABILIZATION

Fly ash stabilized soils should not be constructed without the presence of the geotechnical engineer’s designated representative.

MATERIALS. The fly ash material used in stabilization should meet the physical characteristics of ASTM D 5239 6.4, with a minimum compressive strength of 500 psi at 7-days. The fly ash material should meet the chemical requirements of ASTM C 618, Class C. The source material should be identified and approved by the geotechnical engineer prior to delivery to the site.

Fly ash should be kept free from moisture prior to use. Fly ash stored on the project should be placed in weatherproof bins or buildings with adequate protection from ground dampness.

CONSTRUCTION. The fly ash stabilized soil should be constructed as described herein. The fly ash should be spread uniformly across the prepared soil surface at the full application rate by using an agricultural seed or fly ash spreader or other equipment acceptable to the geotechnical engineer’s designated representative.

Fly ash stabilized material should be placed in approximately horizontal layers not to exceed 12 inches in uncompacted thickness.

Subgrade Preparation. Prior to the beginning of fly ash treatment, the Contractor should construct the subgrade to an elevation that will provide a subgrade surface conforming to the contract documents upon completion of the fly ash treatment.

Fly ash should be spread only on those areas where mixing operations can be completed during the same working day. Mixing and spreading should not be performed during freezing temperatures. When the temperature is below 40 degrees F, the completed base course should be protected against freezing by a sufficient covering of straw, or by other approved methods, until the course has dried out. Any areas of completed base course that are damaged by freezing, rainfall, or other weather conditions should be repaired by the contractor. Fly ash should not be applied when the atmospheric temperature is less than 40 degrees F. No fly ash should be applied to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F, completed fly ash-treated areas should be protected against any detrimental effects of freezing.

The fly ash should be spread with an approved spreader and added as a percentage by weight. The amount of fly ash should be approved by the geotechnical engineer and based on laboratory testing with the soil materials.

If moisture content of the soil exceeds the specified limits, additional fly ash may be added to lower the moisture content. Lowering moisture contents by aeration after the application of fly ash should not be permitted.
GUIDELINE FOR FLY ASH STABILIZATION

The fly ash should be distributed at a uniform rate and in such a manner to prevent the scattering of fly ash by wind. Fly ash should not be added when wind or weather conditions are not favorable in the opinion of the geotechnical engineer's designated representative. A motor grader should not be used to spread the fly ash.

**Mixing.** Mixing should begin within 1 hour of distribution of the fly ash. The fly ash, material, and required water should be thoroughly mixed, blended, and pulverized by approved road mixers or by a depth-controlled rotary tiller. Except as provided hereinafter, the Contractor should continue mixing and applying water until all material will pass a 1-inch screen. Scarifying and mixing should be controlled to provide uniform depth within 0.1 ft of the depth specified. If, in the opinion of the geotechnical engineer's designated representative the material was mixed to a depth greater than indicated on the drawing or as specified herein, additional fly ash should be added to achieve the desired application rate. If in the opinion of the geotechnical engineer's designated representative, the material was mixed to a depth less than indicated on the drawing or specified, the material should be remixed.

Moisture content of the mixture should be determined in preparation for final mixing. Moisture in the mixture following final mixing should not be less than the water content determined to be optimum based on dry weight of soil and should not exceed the optimum water content by more than 5 percentage points. Water may be added in increments as large as the equipment will permit; however, such increment of water should be partially incorporated in the mix to avoid concentration of water near the surface. After the last increment of water has been added, mixing should be continued until the water is uniformly distributed throughout the full depth of the mixture, including satisfactory moisture distribution along the edges of the section.

**Compaction.** Compaction should begin within 2 hours of the start of mixing. The fly ash stabilized subgrade should be compacted in accordance with the requirements for controlled fill. The compaction should be a minimum of 95% of the maximum density in accordance with ASTM D698 and within −2% to +3% of the optimum moisture content of the fly ash-stabilized soil.

The compaction should be achieved using a vibratory pad-foot roller or other equipment approved by the geotechnical engineer's representative.

**Protection and Curing.** The Contractor should protect the finished treated subgrade from rapid drying, for 3 days, by sprinkling with water as often as is necessary to prevent drying of the surface of the fly ash-treated subgrade, or by application of the overlying base course. The Contractor should not allow any vehicles or operations that will distort the surface to the extent that proper curing will be affected on the treated subgrade during the curing period.
SECTION 027410 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cold milling of existing hot-mix asphalt pavement.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving.
   4. Hot-mix asphalt paving overlay.
   5. Pavement-marking paint.

B. Related Sections:
   1. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
   2. Division 2 Section "Pavement Joint Sealants" for joint sealants and fillers at paving terminations.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
   2. Job-Mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the City of Topeka.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Topeka for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Preinstallation Conference: N/A.
1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of [40 deg F (4.4 deg C) for oil-based materials] [55 deg F (12.8 deg C) for water-based materials], and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22 for base asphalt and PG 70-28 for surface lift (2") per City of Topeka Specifications.

B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.

1. Color: As indicated, yellow for parking stalls and symbols, yellow for opposing traffic and white for lane delineation.


1. Color: As indicated, yellow for parking stalls and symbols, yellow for opposing traffic and white for lane delineation.
D. Glass Beads: AASHTO M 247, Type 1.

E. Wheel Stops: Precast, air-entrained concrete, 2500-psi (17.2-MPa) minimum compressive strength, [4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72 inches (1800 mm) long] <Insert dimensions>. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 10-inch (254-mm) minimum length.

F. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; [4 inches (100 mm) high by 6 inches (150 mm) wide by 72 inches (1800 mm) long] <Insert dimensions>. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 10-inch (254-mm) minimum length.
2. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction[; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types";] and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: PG64-22.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches (50 mm).
3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at minimum temperature of 250 deg F (121 deg C).
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.
3.8 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F (121 deg C).

   1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

   1. Base Course: Plus or minus 1/2 inch (13 mm).
   2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

   1. Base Course: 1/4 inch (6 mm)
   2. Surface Course: 1/8 inch (3 mm)
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

   1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.11 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.

B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.
3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 027410
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Formwork for cast-in-place concrete.
   2. Shoring, bracing, and anchoring.
   3. Openings for other Work.
   4. Related accessories.

B. Products Installed But Not Specified Under This Section:
   1. Sleeves, anchor bolts, and embedded items.

C. Related Sections:
   1. Section 032000 - CONCRETE REINFORCEMENT.
   2. Section 033000 - CAST-IN-PLACE CONCRETE.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301-96: Specifications for Structural Concrete for Buildings.
   2. ACI 347R-94: Guide to Formwork for Concrete.

B. APA-The Engineered Wood Association (APA):

C. U.S. Department of Commerce Product Standards (PS):
   1. PS 1-83: Construction and Industrial Plywood.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design, engineer, and construct formwork, shoring, and bracing to conform to design and code requirements, so that resulting concrete conforms to required shapes, lines, and dimensions.
   1. Plywood forms shall be designed according to APA Design/Construction Guide for Concrete Formwork.

1.04 SUBMITTALS
A. Product Data: Manufacturer's specifications and technical data on the following.

1. Form ties.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm experienced in installation of systems similar in complexity to those required for this Project.

C. Regulatory Requirements: Form release agent shall comply with U. S. Government Clean Air Act for maximum volatile organic compound (VOC) as specified in PART 2 of this Section.

1.06 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Exposed Surface Form Material: New or undamaged steel, fiberglass, coated plywood, or high density overlaid plywood of thickness and strength to prevent visible bowing.

B. Concealed Surface Form Material: Steel, fiberglass, sound plywood, or lumber.

2.02 ACCESSORIES

A. Form Ties: Snap-off type, 1-1/2 inch break off dimension, free of defects which could leave holes larger than 1 inch diameter in concrete surface.

B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, or impair natural bonding or color characteristics of concrete, and with maximum volatile organic compound (VOC) of 250 grams per liter.

C. Fasteners: Nails, spikes, lag bolts, or through bolts, sized as required, and of sufficient strength and character to maintain formwork in place while concrete is placed.

D. Corner Chamfer Strips: Rigid plastic or wood.

E. Dovetail Anchor Slots: Galvanized steel, foam filled type or release tape sealed slots type.

1. Size: As required to fit dovetail anchor specified under Section 04300.
2. Gage: 16.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 EARTH FORMS

A. Side forms of footings and grade beams may be omitted and concrete placed directly against excavation at locations indicated on Drawings, or when requested in writing by Subcontractor and accepted by Engineer.

1. Where omission of forms has been accepted by Engineer, provide additional concrete 1 inch on each side of the minimum design profiles and dimensions shown on Drawings.
2. Hand trim sides and bottoms of earth formed excavations.
3. Remove loose soil prior to placing concrete.

3.03 INSTALLATION

A. Comply with the following.

1. ACI 301.

B. Construct forms plumb, straight, and conforming to slopes, lines, and dimensions indicated on Drawings.

C. Minimize form joints. Symmetrically align joints and make sufficiently tight to prevent concrete leakage.

D. Arrange and assemble formwork to permit dismantling and stripping.

E. Provide bracing to ensure stability and true alignment of formwork.

1. Strengthen formwork subject to be overstressed by construction loads.

F. Provide 3/4 inch by 3/4 inch chamfer strips at exposed edges and outside corners of walls.

G. Prior to forming openings in structural members which are not indicated on Drawings, obtain approval of Engineer.

H. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate openings in bottom of forms in inconspicuous location to allow flushing water to drain.

2. Close temporary openings with tight fitting panels, flush with inside face of form, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

I. If formwork is installed after installation of concrete reinforcing resulting in insufficient concrete cover over reinforcement, notify Engineer and request instructions prior to proceeding with Work.

J. Tolerances: Maintain formwork so that completed concrete will conform to dimensional tolerances specified in Section 03300.

3.04 APPLICATION OF FORM RELEASE AGENT

A. Apply to formwork in accordance with manufacturer's recommendations.

1. Apply prior to placing reinforcement steel, anchoring devices and embedded items.

B. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent.

1. Refer to Drawings.
2. Soak contact surfaces of untreated forms with clean water.
3. Keep surfaces wet prior to placing concrete.

3.05 INSTALLATION OF EMBEDDED ITEMS

A. Provide formed openings where required for Work embedded in or passing through concrete.

B. Coordinate Work of other Sections in forming and setting openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts or components required for subsequent construction and equipment or material of other Sections.

C. Install accessories in accordance with manufacturer's instructions, straight, level and plumb. Ensure items are not disturbed during concrete placement.

D. Install dovetail anchor slots in concrete walls which will serve as back-up for masonry, and where indicated on Drawings.

1. Install slots vertically spaced 16 inches on center, unless otherwise indicated on Drawings.

3.06 FORM CLEANING

A. Clean forms to remove foreign matter as erection proceeds and immediately prior to concrete placement.

1. Flush form cavity with water or compressed air to remove dirt and debris.
2. During cold weather, remove ice and snow from within forms.
3.07 FIELD QUALITY CONTROL

A. Inspections:
   1. Verify formwork dimensions and elevations prior to concrete placement.
   2. Monitor formwork movements during concrete placement to ensure tolerances are maintained.

3.08 FORM REMOVAL

A. Comply with ACI 347, except do not remove forms or bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.

B. Forms not supporting weight of concrete, such as sides of walls, columns, and similar elements, may be removed after cumulatively curing at not less than 50 degrees F. for 48 hours after placement of concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

C. Forms supporting weight of concrete, such as beam soffits and other structural elements, shall not be removed in less than 7 days after placement of concrete, and until concrete has attained 75 percent of-specified 28 day minimum compressive strength.

   1. Potential in-place compressive strength of concrete shall be determined by testing of field cured test specimens representative of concrete location or members.

D. Remove formwork progressively so no unbalanced loads are imposed on structure.

   1. Do not damage concrete surfaces during form removal.
SECTION 032000 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Reinforcing bars.
   3. Related accessories.

B. Related Sections:
   1. Section 031000 - CONCRETE FORMS AND ACCESSORIES.
   2. Section 033000 - CAST-IN-PLACE CONCRETE.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301-96: Specifications for Structural Concrete for Buildings.
   2. ACI 318-95/318-95: Building Code Requirements for Reinforced Concrete and Commentary.

B. American Society for Testing and Materials (ASTM):
   2. ASTM A615/A615M-96a: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C. Concrete Reinforcing Steel Institute (CRSI):

1.03 SUBMITTALS

A. Submit in accordance with the General Conditions and Special Conditions.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, plus the following specific requirements.
   1. Comply with ACI SP-66.
   2. Indicate size, spacing, location, and quantities of reinforcement steel and welded wire fabric, bending and cutting schedules, diagram of bent bars, splicing, stirrup spacing, supporting and spacing devices, and construction joint locations.
   3. Prepare shop drawings at the following scales.
a. Plans: Not less than 1/8 inch = V-0''.
b. Sections and details: Not less than 1/2'' V-0''.

4. Include elevations of walls constructed of reinforced concrete masonry units at a scale of not less than 3/8 ''=V-0''.
   a. Indicate all openings, pilasters, control joints, bond beams, and other information required to fully detail reinforcing occurring within walls.

5. Do not reproduce Contract Documents in whole or in part for use as shop drawings.

C. Quality Control Submittals:
   1. Test reports:

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm experienced in installation of systems similar in complexity to those required for this Project, plus the following.
   1. Not less than 3 years experience with systems.
   2. Successfully completed not less than 5 comparable scale projects using this system.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

C. Store steel materials off ground.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcement Steel: ASTM A615/A615M, Grade 60, deformed.

B. Stirrup steel: ASTM A615/A615M, Grade 60.


2.02 ACCESSORIES
CONCRETE REINFORCEMENT
032000-3

A. Tie Wire: Not less than 16 gauge annealed steel.

   1. Provide plastic coating at locations adjacent to weather exposed concrete surfaces.
   2. Provide load bearing pad on bottom of items in contact with vapor barrier.
   3. Provide plastic feet on chairs and supports.

2.03 FABRICATION

A. Shop fabricate in accordance with the following.
   1. ACI SP-66.

B. Locate reinforcement splices not indicated on Drawings at points of minimum stress.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion.
   1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection: Do not displace or damage vapor barrier.

3.03 INSTALLATION

A. Place, support, and secure reinforcement against displacement using chairs, bolsters, bar supports, and spacers specified in this Section.
   1. Do not deviate from required position.
   2. Accommodate placement of formed openings.

B. Preserve clearance between bars of not less than 1 inch, not less than 1 bar diameter, or 1-1/3 times large aggregate, whichever is greater.

C. Provide the following concrete coverage over reinforcement unless otherwise indicated on Drawings.
   1. In excavations:
      a. 3 inches above subgrade.
      b. 3 inches from sides of earth forms.
   2. From sides of forms: 2 inches.
3. Slabs on grade:
   a. 2 inches from subgrade.
   b. 1-1/2 inches for top steel.


D. Splices: Lap splices as indicated on Drawings.
   1. Bars indicated to be continuous, and all vertical bars, shall be lapped not less than 30 bar diameters at splices.
   2. Stagger splices in accordance with ACI 318.

E. Corners, Openings and Obstructions:
   1. Place 2 additional number 5 bar, 4 feet long, diagonally in each face at corners, unless indicated otherwise on Drawings.
   2. Openings:
      a. Place 2 additional number 5 bars, opening dimension plus 60 bar diameters long, at each side of opening.
      b. Place 2 additional number 5 bars, 5 feet long, at each corner of opening.
      c. Place number 4 hoop around all round openings.
   3. Adjust bar locations to avoid interference with inserts, sleeves, and other reinforcement.
      a. When adjustment exceeds 25 percent of spacing within plane, or 1 bar diameter perpendicular to plane of reinforcement, consult Engineer for review of layout.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with the General Conditions and Special Conditions.

B. Inspections: Verify installed Work is in compliance with Contract Documents.

END OF SECTION 032000
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   2. Related accessories.

B. Related Sections:
   1. Section 031000 - CONCRETE FORMS AND ACCESSORIES.
   2. Section 032000 - CONCRETE REINFORCEMENT.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   2. ACI 301-96: Specifications for Structural Concrete for Buildings.
   3. ACI 302.1 R-89: Guide for Concrete Floor and Slab Construction.
   5. ACI 305R-91: Hot Weather Concreting.
   8. ACI 308-92: Standard Practice for Curing Concrete.

B. American Society for Testing and Materials (ASTM):

1.03 SUBMITTALS

A. Product Data: Manufacturer’s specifications and technical data for joint devices, accessories, and admixtures, including the following.
   1. Detailed specifications of construction and fabrication.
   2. Manufacturer’s installation instructions.

B. Concrete Design Mix: Submit for each class of concrete.
   1. Include description of method by which mix design was formulated and supporting backup data.
      a. Mix designs shall have a history of not less than 9 test cylinders.
   2. Include manufacturer’s product data sheets for each admixture.

C. Quality Control Submittals:
   1. Design data.
   2. Laboratory test reports.
      a. Aggregate gradation.
      b. Deleterious substances within aggregate.
      c. Aggregate durability.
      d. Mix additives.
      e. Cement.
   3. Statement of compliance with regulatory requirements specified in this Section.
   4. Field quality control Submittals are specified under PART 3 of this Section.

D. Contract Closeout Submittals:
   1. Project Record Documents. a. Record actual location of embedded utilities and components which are concealed from view.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Not less than 6 years experience in the actual production of specified products.

B. Installer’s Qualifications: Firm experienced in installation of systems similar in complexity to those required for this Project, plus the following.
   1. Not less than 3 years experience with systems.
   2. Successfully completed not less than 5 comparable scale projects using this system.
C. Product/Material Qualifications: Acquire cement and aggregate from same source for all Work.

D. Regulatory Requirements: Curing compound shall comply with U. S. Government Clean Air Act for maximum volatile organic compound (VOC) as specified in PART 2 of this Section.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.

1. Ready mixed concrete shall be handled and preserved in its "batched" proportions during transportation.
2. Mixing time shall not exceed the following.
   a. 45 minutes when ambient temperature is above 80 degrees F.
   b. 60 minutes when ambient temperature is below 80 degrees F.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. When maximum daily temperature exceeds 85 degrees F. or rapid drying conditions exist (evaporation rate exceeds 0.20 pounds per square foot per hour as determined by ACI 305R, Figure 2.1.5) comply with ACI 301 and ACI 305R. The following precautions shall be taken, as may be appropriate.
   a. Cool ingredients before mixing to maintain concrete temperature at point of placement below 90 degrees F. 1) Mixing water may be chilled, or chopped ice may be used provided Water equivalent of ice is calculated to total amount of mixing water. 2) Liquid nitrogen may be used to cool concrete.
   b. Cover reinforcement steel with water-soaked burlap to maintain steel temperature at or below ambient air temperature at time of placement of concrete.
   c. Fog spray forms, reinforcement steel, and subgrade immediately prior to concrete placement.

2. Maintain subgrade moisture uniform without creating water puddles or dry areas.
   a. Use water-reducing retarding admixture (ASTM C494, Type D) when required by high temperatures, low humidity, or other adverse concrete placing conditions, as acceptable to Engineer.
   b. Provide evaporation retardant over freshly screeded concrete to prevent moisture loss and plastic shrinkage cracks.

3. When mean daily temperature is below 40 degrees F. comply with ACI 301, ACI 306.1, and as follows.
a. Protect concrete from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures.
b. Uniformly heat water and aggregates prior to mixing to obtain concrete temperature of not less than 50 degrees F. and not more than 80 degrees F. at point of placement.
c. Do not use frozen materials or materials containing ice or snow.
d. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
e. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix design.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150 Type 1, Normal.
B. Coarse Aggregate: ASTM C33, Size Number 67
C. Fine Aggregate: ASTM C33, Fine Aggregate
D. Water: Clean and not detrimental to concrete.
E. Admixtures:
   2. Water-reducing admixture: ASTM C494, Type A.
   3. Water-reducing and retarding admixture: ASTM C494, Type D.
   4. Water-reducing accelerating admixture: ASTM C494, Type E.
   5. Water-reducing, high range admixture: ASTM C494, Type F.
   6. Water-reducing, high range and retarding admixture: ASTM C494, Type G.
   7. Calcium chloride: Not permitted.

2.02 ACCESSORIES

A. Vapor Barrier: Basis of Design – Stego Wrap Vapor Barrier (15 mil) by Stego Industries or equal. Fungi resistant, polyethylene sheet conforming to ASTM D2103 Type 1, recommended for below grade application.
B. Vapor Barrier Tape: Polypropylene self adhering type.
   1. Width: Not less than 2-1/2 inches.
   2. Acceptable manufacturer:
      a. Basis of Design – Stego Industries or equal.
D. Bond Breaker: ASTM D2178, No. 15 unperforated asphalt glass felt.
E. Keyways: Nominal 2 inch thick lumber or metal screed key, cut to size and shape indicated on Drawings.

F. Evaporation Retardant:
   1. Acceptable manufacturers and product:
      a. Master Builders, Inc.: ConFilm.
      b. Comparable products of the following manufacturers:
         (a) Conspec Marketing & Manufacturing Co., Inc.
         (b) The Euclid Chemical Company.
         (c) L & M Construction Chemicals, Inc.
      c. Substitutions: Comply with the General Conditions and Special Conditions.

G. Curing Materials: Contractor has option of the following.
   1. ASTM C171 Type 1, sheet material.
   2. ASTM C309, Type 1 D, Class B, minimum 30 percent solids, curing compound with maximum volatile organic compound (VOC) of 250 grams per liter, provided compound is compatible with floor finish specified in other Sections.
      a. Moisture loss shall not exceed 0.039 grams per square centimeter when curing compound is applied at the rate of 150 square feet per gallon.
   3. Ponding or continuous sprinkling of water.

2.03 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

C. Proportion mixes to provide concrete with the following properties:
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
      a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.

D. Cement Content: The concrete shall have a minimum of 564 pounds of portland cement per cubic yard.
E. Aggregate: The concrete shall contain 30 percent coarse and 70 percent fine aggregate by weight of the total aggregate content.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:

1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
2. Air Content: 6.0 percent for 1-inch maximum aggregate.
3. Air Content: 6.0 percent for 3/4-inch maximum aggregate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation:

1. Immediately before concrete placement, thoroughly wet moisture absorbing material that will be in contact with concrete.
   a. Do not let standing water develop.

2. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3. In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.03 INSTALLATION OF JOINT DEVICES

A. Install at locations indicated on Drawings, and as follows.

1. Separate exterior slabs on grade from vertical surfaces with 1/2 inch thick joint filler.

B. Extend joint filler from bottom of slab to within 1/2 inch of finished slab top surface.

C. Install construction joint device in coordination with floor slab pattern and placement sequence.

1. Set top of device to required elevation.
2. Secure device to resist movement.
3.04 INSTALLATION OF VAPOR BARRIER

A. Coordinate with Section 02361 for placement of termite treatment.
B. Install directly under interior floor slabs on grade.
C. Lap joints 6 inches and seal with vapor barrier tape.
D. Protect vapor barrier during placement of reinforcement and concrete.
   1. Repair punctures and tears with vapor barrier tape.

3.05 CONCRETE PLACEMENT AND CONSOLIDATION

A. Notify Engineer and testing laboratory not less than 24 hours prior to commencement of concrete operations.
B. Perform Work in accordance with the following.
   1. ACI 301.
   2. ACI 302.1R.
   3. ACI 309R.
   4. ACI 318.
C. Do not allow free fall of concrete to exceed 5 feet.
D. Place concrete continuously between predetermined expansion, control and construction joints.
E. Do not interrupt successive placement; do not permit cold joints to occur.
F. Consolidate concrete by vibration in accordance with ACI 309R.
G. Screed floors and slabs on grade, level, as indicated on Drawings and specified in this Section.
H. Saw cut control joints at locations indicated on Drawings.
   1. Saw cut joints as soon as floor slab will support weight of saw and operator without dislodging aggregate or disturbing final finish.
   2. Saw cut joints to 1/8 inch wide by 3/4 inch deep, unless otherwise indicated on Drawings.
   3. Complete sawing of joints within 2 hours after finishing at each joint location.
      a. Do not allow shrinkage process to begin until after control joints have been sawn.

3.06 CONCRETE FINISHING

A. Conform to ACI 301 Chapters 10 and 11 for the following.
2. Exposed exterior surfaces: Smooth form finish.
4. Interior slabs: Floated finish followed by a power troweled and hand steel troweled finish.

3.07 CURING AND PROTECTION

A. Conform to ACI 301 Chapter 12, ACI 308, and as specified in this Section using curing options specified under PART 2 of this Section.

B. Protect concrete from premature drying, excessively hot or cold temperatures, and damage.

C. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary, but not less than 7 days, for hydration of the cement and hardening of the concrete.

D. If polyethylene sheet is used, place sheet over concrete as soon as finish can be walked on.
   1. Lap edges not less than 6 inches and seal in place.
   2. Secure in place to prohibit air from circulation under sheet.

E. If curing compound is used, install in accordance with manufacturer's instructions.

F. When mean daily outdoor temperature is less than 40 degrees F., temperature of concrete shall be maintained between 50 and 70 degrees F. for the required curing period.
   1. Arrangement for heating, covering, insulating, or housing of concrete shall be made prior to placement of concrete, and shall be adequate to maintain required temperature without injury of concrete due to concentration of heat.

G. In very hot, windy weather, make arrangements for windbreaks, sunshades or fog nozzles.
   1. Protection of concrete shall be taken as quickly as concrete hardening and finishing operations will allow.
   2. Provide evaporation retardant over freshly screeded concrete to prevent moisture loss and plastic shrinkage cracks.

H. Changes in temperature of air immediately adjacent to concrete during and immediately following curing period shall be maintained as uniform a possible, and shall not exceed 5 degrees F. in any 1 hour or 50 degrees F. in any 24 hour period.

3.08 TOLERANCES

A. Conform to ACI 117 as follows.
   1. Formed surfaces:
      a. Variation from plumb: 1/4 inch in 10 foot length.
      b. Variation from building lines and dimensions: 1/2 inch in 20 foot length.
c. Variation in thickness of slabs and walls: Minus 1/4 inch, plus 1/2 inch.

2. Footings:
   a. Variation in dimension in plan: Minus 1/2 inch, plus 2 inches.
   b. Misplacement or eccentricity: 2 percent of the footing width in the direction of misplacement but not more than 2 inches.

3. Slabs:
   a. Specified overall value (SOV): FF 35 and FL 25 measured in accordance with ASTM E1 155.
   b. Minimum local value (MLV): FF 24 and FL 17 measured in accordance with ASTM E1 155.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with the General Conditions and Special Conditions.

B. Delivery Tickets: For each load delivered, submit 3 copies indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, and design slump at time of batching.

C. Test: Test shall include those specified in ACI 301 Sections 16.3, 16.4, and 16.5, modified as follows.
   1. Test cylinders of concrete shall be taken for every 50 cubic yards or portion thereof for each class of concrete placed each day.
      a. One additional set of test cylinders will be taken during cold weather, and as directed by Engineer, cured at Project Site under same conditions as concrete it represents.
   2. Slump test shall be taken for each set of test cylinders.

3.10 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete which, in the opinion of the Engineer, does not conform to required lines, details, dimensions, tolerances, or specified requirements, or, in the opinion of the Engineer, concrete with excessive honeycomb or embedded debris.

B. Concrete which has been determined by Engineer to be defective, shall be repaired or replaced as directed by Engineer.
   1. Surface defects, including tie holes, shall be repaired immediately after form removal and observation by Engineer.

END OF SECTION 033000
SECTION 042200 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Concrete masonry units.
   2. Mortar and grout.
   3. Steel reinforcing bars.
   5. Miscellaneous masonry accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
   3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Integral water repellent used in CMU's
   3. Cementitious materials. Include name of manufacturer, brand name, and type.
   5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   6. Grout mixes. Include description of type and proportions of ingredients.

B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day’s work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. **Cold-Weather Cleaning:** Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. **Hot-Weather Requirements:** Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

**PART 2 - PRODUCTS**

### 2.1 MANUFACTURERS

A. **Source Limitations for Masonry Units:** Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. **Source Limitations for Mortar Materials:** Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 UNIT MASONRY, GENERAL

A. **Masonry Standard:** Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. **Defective Units:** Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

### 2.3 CONCRETE MASONRY UNITS

A. **Shapes:** Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.

B. **CMUs:** ASTM C 90.
   1. **Unit Compressive Strength:** Provide units with minimum average net-area compressive strength of 2150 psi.
   2. **Density Classification:** Lightweight.
   3. **Size (Width):** Manufactured to dimensions 3/8 inch less than nominal dimensions.
   4. **Exposed Faces:** Manufacturers standard color and texture unless indicated otherwise.

C. **Integral Water Repellent:** Provide units made with integral water repellent for exposed units.
   1. **Integral Water Repellent:** Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Aggregate for Mortar: ASTM C 144
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Grout for bond beams and vertical cells shall conform to ASTM C 476 and shall have a minimum compressive strength of 2500 psi at 28 days.


H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
   1. Products: Subject to compliance with requirements, provide one of the following and as approved by the masonry unit manufacturer:
      a. ACM Chemistries; RainBloc for Mortar.
      b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.

J. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Interior Walls: Mill- galvanized carbon steel.
   2. Exterior Walls: Hot-dip galvanized carbon steel.
   3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
   4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
   6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bard in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops for four loops as needed for number of bars indicated.

2.7 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements: Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
   1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
   2. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
   3. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
4. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

G. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
1. Install compressible filler in joint between top of partition and underside of structure above.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.
   4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.8 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor shall engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare reports.
   1. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

C. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

D. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780.

E. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

F. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
   6. Clean stone trim to comply with stone supplier's written instructions.
3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000
SECTION 047300 - SIMULATED STONE VENEER

PART 1 - GENERAL

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. Simulated stone veneers for exterior applications adhered to wood framing and sheathing.
   2. Reinforcement, anchorages, mortar, flashing and accessories.

B. Related Requirements:

1.3 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Samples:
   1. For each stone type indicated.
   2. For each color of mortar required.

1.4 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.5 WARRANTY

A. Special Warranty: Warranty covers manufacturing defect of manufactured stone products. Warranty does not include labor for material replacement.
   1. Materials-Only Warranty Period: 40 years from date of Substantial Completion.

PART 2 - PRODUCTS

2. MATERIALS

A. Provide Boulder Creek Stone Manufactured Stone Veneer.
   1. Style: Country Ledge
   2. Thickness: Varies from 1-inch to 3.5-inches
3. Color: S4095-7 West Chester

B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D.


D. Aluminum Sheet Flashing: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
   1. ALSCO Coated Finish (Contractor’s Option):
      b. Striated PVC

E. Fasteners:
   1. 1.75-inch galvanized roofing nails or staples
   2. Corrosion resistant, Number 8 self-tapping metal screws.

F. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients designed for veneer applications and tuckpointing of manufactured stone.
   1. Quikrete; Veneer Stone Mortar

G. Water: Potable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate indicated to receive stone veneer prior to installation of wire lath, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ADHERED STONE VENEER

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed. Install flashing over sheathing and behind weather-resistant sheathing paper by fastening through sheathing into framing.
   1. Apply 2-layers of building paper horizontally with a 2-inch overlap and a 6-inch end lap; fastened to sheathing with galvanized staples or roofing nails.

B. Install lath over weather-resistant sheathing paper by fastening through sheathing into framing to comply with ASTM C 1063.

C. Install lath over unit masonry and concrete to comply with ASTM C 1063.
   1. Install lath horizontally
   2. Overlap a minimum of 2-inches on the vertical seams, and at least 1-inch on the horizontal seams. The overlapping lath must begin or end on a framing member.
3. Use fasteners that will penetrate the framing members a minimum of 1-inch. Fasteners to be places every 6-inches vertically into framing members.
4. Fold the lath tightly around corners and fasten to both faces of the corner.
5. Do not install with a seam on a corner.

D. Install scratch coat over metal lath 3/8 inch thick to comply with ASTM C 926.

E. Thoroughly wet the scratch coat with water prior to applying the setting bed mortar and stone. Use sufficient setting mortar so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat.

F. Start installation at corners and work toward the center of the wall. Alternate long and short returns on corner pieces.

G. Apply the stone veneer.
   1. Layout pattern prior to beginning work.
   2. Build in items plumb and level.
   3. The back of each stone should be entirely buttered with mortar mixture to a nominal 3/8-inch thickness.
   5. Firmly work the stone onto the scratch coat while pressing and moving back and forth to set the stone. Mortar should slightly ooze or squeeze out around the edges of the stone during this process.
   6. Apply grout in gaps between the stones to slightly above the desired finish depth. Let the grout dry until firm but not solid. Strike joints to achieve the desired look.

3.3 ADJUSTING AND CLEANING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds.
   1. Obtain approval from Architect prior to cutting or fitting any area not indicated on the drawings or where appearance or strength of masonry work may be impaired.

B. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

C. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
   1. Remove excess mortar and smears with medium bristled brush or steel wool.
   2. Replace defective mortar. Match adjacent work.
   3. Clean soiled surfaces with non-acidic solution, acceptable to stone veneer manufacturer.
   4. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

END OF SECTION 047300
SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
   1. Weight Class: Standard.
   2. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements.
2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

C. Finish: Plain

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Threaded Rods: ASTM A 36/A 36M.
   2. Washers: ASTM F 436, Type 1, hardened ASTM A 36/A 36M carbon steel.
   3. Finish: Plain.

F. Headed Anchor Rods: ASTM F 1554, Grade 55, straight.
   3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   3. Mark and match-mark materials for field assembly.
   4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


   1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, field welds will be tested and inspected according to
      AWS D1.1/D1.1M and the following inspection procedures, at testing agency’s option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on
         finished weld. Cracks or zones of incomplete fusion or penetration will not be
         accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to
   requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree
      flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors
      already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the
   Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair
   galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged
   or missing and paint with the same material as used for shop painting to comply with SSPC-
   PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool
      cleaning.

END OF SECTION 05 12 00
SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel framing and supports for operable partitions.
   2. Steel framing and supports for countertops.
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   5. Elevator machine beams, hoist beams.
   6. Steel shapes for supporting elevator door sills.
   7. Metal ladders.
   8. Metal bollards.

B. Products furnished, but not installed, under this Section:
   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Sections:
   1. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
   2. Section 05 12 00 "Structural Steel Framing."
   3. Section 05 51 00 "Metal Stairs."

1.3 PERFORMANCE REQUIREMENTS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
1.7 COORDINATION

A. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
D. Machine Screws: ASME B18.6.3.
E. Lag Screws: ASME B18.2.1.
H. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
I. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.


2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

2.7 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3 unless otherwise indicated.
   2. For elevator pit ladders, comply with ASME A17.1.

B. Steel Ladders:
   1. Space siderails 18 inches apart unless otherwise indicated.
   2. Space siderails of elevator pit ladders 12 inches apart.
   5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
      a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         1) IKG Industries, a division of Harsco Corporation; Mebac.
         2) SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
   7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.
   1. Cap bollards with 1/4-inch- thick steel plate.

B. Prime bollards with zinc-rich primer.
2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with universal shop primer unless indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers’ written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00
SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the framing with the following:
   1. Dimension lumber.
   2. Engineered Wood Products
      a. Laminated Veneer Lumber (LVL)
      b. Parallel Strand Lumber (PSL)
      c. Laminated Strand Lumber (LSL)
   3. Shear wall panels.
   4. Rooftop Equipment Bases and Support Curbs
   5. Wood blocking and nailers.
   6. Wood furring and grounds.
   7. Plywood backing panels.

B. Related Requirements:
   1. Section 06 16 00 “Sheathing” for subflooring, wall and roof sheathing.
   2. Section 06 17 53 “Shop-Fabricated Wood Trusses” for wood trusses made from dimension lumber.

1.3 REFERENCES

A. American Wood Protection Association (AWPA) Publications
   1. C2 “Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Processes”
   2. C9 “Plywood – Preservative Treatment by Pressure Process Document Number”
   3. M4 “Standard for the Care of Preservative-Treated Wood Products Document Number”

B. ASTM International Publications
   1. A153 “Standard for specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware”
   2. A307 “Standard Specification for Carbon Steel Bolts and Studs, 60 000psi Tensile Strength”
   4. A653 “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”

C. The Engineered Wood Association (APA) Publications
1.4 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   5. WCLIB: West Coast Lumber Inspection Bureau.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.
   1. Engineered wood products
   2. Underlayment
   3. Metal framing anchors
   4. construction adhesives

B. Shop Drawings: For Engineered Wood Framing Systems provide layout drawings indicating materials, member sizes, member spacing and accessories required for proper installation. Drawings shall clearly reference construction details.

C. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing and finishing treated materials.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

D. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

C. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood product from one source and by a single manufacturer.

D. Product Identification: All Engineered Wood Products System members shall be clearly marked with manufacturer’s name, product series, plant identification, date of manufacture, and code compliance.

E. Installation Review: The Engineered Wood Products System Manufacturer’s Technical Representative shall be available to meet with the Contractors to review installation details prior to the beginning of framing. The Contractor shall give notification to the Technical Representative prior to enclosing the framing to provide opportunity for review of the installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1. Store Engineered Wood materials on dry surfaces supported on raised wood sticks located every 10 feet. Store TJI joists in an upright position.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.
5. Provide lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicate.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them include the following:

1. Northeastern Lumber Manufacturers Association (NELMA)
2. National Lumber Grades Authority (Canadian) (NLGA)
3. Southern Pine Inspection Bureau (SPIB)
4. West Coast Lumber Inspection Bureau (WCLIB)
5. Western Wood Products Association (WWPA)

### 2.2 FIRE-RETARDANT-TREATED MATERIALS

**A. General:** Where fire-retardant-treated materials are indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; SGS U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspection agency acceptable to authorities having jurisdiction.

1. Provide fire treated wood in all concealed areas of construction, as shown or indicated on the drawings, and as required by code.
2. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

**B. Interior Type A:** For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
3. Contact with treated wood does not promote corrosion of metal fasteners.

**C. Exterior Type:** Use for exterior locations and where indicated. Comply with ASTM D2898.

**D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.**

**E. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.**

### 2.3 WOOD-PRESERVATIVE-TREATED LUMBER

**A. Preservative Treatment by Pressure Process:** AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

**B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.**

**C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.**

**D. Application:** Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.
2.4 DIMENSION LUMBER FRAMING

A. Moisture Content: 15 percent maximum for lumber items not specified to receive preservative treatment.

B. Non-Load-Bearing Interior Partitions:
   1. Construction or No. 2 grade.
   2. Species: Any species with a modulus of elasticity and extreme fiber stress in bending as indicated on Drawings.
      a. Exception: Southern (yellow) pine is not permitted.

C. Exterior and Load-Bearing Partitions:
   1. No. 1 grade.
   2. Species: Any species with a modulus of elasticity and extreme fiber stress in bending as indicated on Drawings.
      a. Exception: Southern (yellow) pine is not permitted.

D. Ceilings (Non-Load-Bearing): For ceiling framing that does not support a floor, roof, or attic provide the following grade and species:
   1. Construction or No. 2 grade.
   2. Species: Any species with a modulus of elasticity and extreme fiber stress in bending as indicated on Drawings.
      a. Exception: Southern (yellow) pine is not permitted.

E. Other Framing Not Listed Above:
   1. No. 1 grade.
   2. Species: Any species with a modulus of elasticity and extreme fiber stress in bending as indicated on Drawings.
      a. Exception: Southern (yellow) pine is not permitted.

F. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
   1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products, General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.

B. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, which meet or exceed those indicated. Manufacturer’s published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Basis-of-Design Product: Engineered wood products indicated on the Drawings have been designed using TrusJoist by Weyerhaeuser. Alternate engineered wood products shall have published design properties and allowable design loads that meet or exceed those by TrusJoist. Manufacturer’s published values shall be determined from empirical data or by rational
engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Subject to compliance with requirements, provide product indicated on the Drawings or an approved comparable product by one of the following:

1. Georgia Pacific  
2. Louisiana-Pacific Corporation  
3. Weyerhaeuser Company

D. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

E. Laminated-Veneer Lumber (LVL): Structural composite lumber made from wood veneers in a continuous press to produce members with grain of veneers parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Construction: Continuous laminated veneer lumber free from finger or scarf joints. Stress graded veneers bonded with waterproof adhesive with face grain parallel to each adjacent layer. Provide Watershed Overlay coating and edge seal to prevent cupping and moisture damage.

2. Comply with the following:
   a. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
   b. Modulus of Elasticity, Edgewise: 1,900,000 psi.
   c. Tension Parallel to Grain: 1555 psi
   d. Compression Parallel to Grain: 2510 psi
   e. Compression Perpendicular to Grain: 750 psi perpendicular to and 480 psi parallel to glue line.
   f. Horizontal Shear: 285 psi perpendicular to and 190 psi parallel to glue line.

F. Parallel-Strand Lumber (PSL): Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products Weyerhaeuser Company; TrusJoist. No substitutions will be accepted.

2. Construction: Continuous stranded lumber bonded with waterproof adhesive and formed into billets. Beams shall be of single-ply construction and fee from finger joints or splices for full length of span.

3. Comply with the following:
   a. Extreme Fiber Stress in Bending: 2900 psi for 12-inch nominal-depth members.
   b. Modulus of Elasticity: 2,000,000 psi.
   c. Tension Parallel to Grain: 2,025 psi
   d. Compression Parallel to Grain: 2900 psi
   e. Compression Perpendicular to Grain: 750 psi perpendicular to and 475 psi parallel to glue line.
   f. Horizontal Shear: 210 psi perpendicular to and 290 psi parallel to glue line.

G. Prefabricated Wood I-Joists (TJI): Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products Weyerhaeuser Company; TrusJoist. No substitutions will be accepted.
2. Web Material: Provide webs manufactured with saw tooth edge detail interlocked and glued at panel joints. Joist web material must not exceed 12% tested average thickness swell due to moisture complying with DOC PS 1 or DOC PS 2, Exposure 1.
   a. Oriented strand board or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.

3. Flange Material: Provide continuous flanges, by manufacturer free from finger or scarf joints for the length of the joists.
   a. Laminated-veneer lumber
   b. Southern pine dimension lumber
   c. Spruce-pine-fir dimension lumber

4. Structural Properties: Establish and monitor structural capacities according to ASTM D 5055.

5. Sizes: Provide units with depths and widths as indicated on Drawings, with flanges not less than 1-1/2 inches in actual width.

H. Laminated Strand Lumber (LSL):
   1. Prefabricated Wood Rim Joists: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
      a. Manufacturer: Provide products by same manufacturer as I-joists.
      b. Material: Solid piece of laminated strand lumber sized to match depth of joist.
   2. Laminated Strand Lumber Headers: Laminated strand lumber; strands of aspen or yellow poplar bonded with waterproof resins; cured using a steam injection process.
      a. Manufacturer: Provide products by same manufacturer as I-joists.

2.6 CONCEALED, PERFORMANCE-RATED STRUCTURAL USE PANELS

A. General: Where structural-use panels are indicated for the following concealed types of applications, provide APA-performance-rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail (where applicable).
   1. Thickness: Provide panels meeting requirements specified but not less than thickness indicated.

B. Combination Subfloor-Underlayment: APA-rated Plywood.
   1. Exposure Durability Classification: Exposure 1.
   2. Span Rating: Not less than 16
   4. Edge Detail: Tongue and groove.
   5. Surface Finish: Fully sanded face.

C. Combination Subfloor-Underlayment: Oriented-Strand-Board
   1. Exposure Durability Classification: Exposure 1.
   2. Span Rating: Not less than 16
   4. Edge Detail: Tongue and groove.
5. Surface Finish: Fully sanded face.

D. Subflooring: APA-rated-plywood sheathing

1. Exposure Durability Classification: Exposure 1.
2. Span Rating: Not less than 16
4. Edge Detail: Tongue and groove.

E. Subflooring: Oriented-Strand-Board

1. Exposure Durability Classification: Exposure 1.
2. Span Rating: Not less than 16
4. Edge Detail: Tongue and groove.

2.7 STRUCTURAL-USE PANELS FOR BACKING

A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with DOC PS 1, Grade C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick.

2.8 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
5. Furring.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:

1. Spruce-pine-fir; NLGA.
2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.9 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.10 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.


D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Attach sheathing to comply with ASTM C954.

G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

H. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.11 METAL FRAMING ANCHORS

A. Basis-of-Design Product: Provide products by Simpson Strong-Tie Company, Inc. No substitutions will be accepted.

B. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:

1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.

2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation; structural, commercial or lock-forming quality, as standard with manufacturer for type of anchor indicated.

D. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.

1. Minimum thickness: 0.052 inch.
E. **Top Flange Hangers:** U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
   1. **Thickness:** 0.052 inch
   2. Designed for connection of engineered wood products, sized to support design loads.

F. **Bridging:** Rigid, V-section, nailless type, 0.064 inch thick, length to suit joist size and spacing.

G. **Post Bases:** Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch-minimum side cover, socket 0.064 inch thick, and standoff and adjustment plates 0.108 inch thick.

H. **Joist Ties:** Flat straps, with holes for fasteners, for tying joists together over supports.
   1. **Minimum thickness:** 0.052 inch.
   2. **Length:** As indicated.

I. **Rafter Tie-Downs (Hurricane Ties):** Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-5/8 inches wide by 0.052 inch thick.

J. **Floor-to-Floor Ties:** Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.052 inch thick by 36 inches long.

K. **Hold-Downs:** Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

2.12 **MISCELLANEOUS MATERIALS**

A. **Sill-Sealer Gaskets:** Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. **Adhesives for Gluing Panels to Framing:** Formulation complying with APA and ASTM C 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.

C. **Water-Repellent Preservative:** NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

**PART 3 - EXECUTION**

3.1 **INSTALLATION, GENERAL**

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. **Framing Standard:** Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. **Framing with Engineered Wood Products:** Install engineered wood products to comply with manufacturer's written instructions.
D. Install framing members of size and at spacing indicated.

E. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

F. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

G. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

H. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

I. Do not splice structural members between supports unless otherwise indicated.

J. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

K. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal-thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

L. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

O. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
   1. Comply with indicated fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.

B. Construct corners and intersections with three or more studs. Provide miscellaneous blocking and framing as shown and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide continuous horizontal blocking at midheight of single-story partitions and multistory partitions, using members of 2-inch nominal thickness and of same width as wall or partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
   1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 36 inches in width, and not less than 6-inch nominal depth for wider openings.

D. Provide diagonal bracing in shear walls, at locations indicated, full story height, unless otherwise indicated. Provide one of the following:
1. Plywood panels, not less than 48 by 96 inches applied vertically.
2. Performance-rated structural-use panels, not less than 48 by 96 inches applied vertically.

### 3.5 FLOOR JOIST FRAMING INSTALLATION

**A. General:** Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

**B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.**

**C. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.**

**D. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.**

**E. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into masonry with ends bent at right angles 4 inches into grouted masonry.**

**F. Under jamb studs at openings, provide solid blocking between joists.**

**G. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.**

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

**H. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.**

1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal-size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.
3. Bridging may be omitted where joist depth is 12-inch nominal size or less, and where indicated live load is 40 psf or less.

**I. Prefabricated Wood I-Joists:**

1. Comply with manufacturer’s written instructions for design, installation, and fastening.
2. Allowable deflection:
   a. Floor Joists: L/360 live load deflection; L/240 total load deflection.
3. Permanently bond the subfloor to the joists using waterproof construction adhesive and nails.
5. Intermediate bearing: 3-1/2” minimum bearing. Blocking panels shall be installed between the joists when load bearing walls are located above the bearing point.

**J. Engineered Wood Beams:**
1. Comply with manufacturer’s written instructions for design, installation, and fastening.
2. Allowable deflection:
   a. Floor Beams: L360 live load deflection; L240 total load deflection.
3. Protect wood members from direct contact with concrete or masonry.
4. Refer to manufacturer’s literature for connection of multiple plies of side loaded beams.

3.6 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
   1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
   1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
   2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal-size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

E. Prefabricated Wood I-Joists:
   1. Comply with manufacturer’s written instructions for design, installation, and fastening.
   2. Allowable deflection:
      a. Roof Joists: L360 live load deflection; L/240 total load deflection.
   3. Permanently bond the subfloor to the joists using waterproof construction adhesive and nails.
   5. Intermediate Bearing: 3-1/2” minimum bearing. Blocking panels shall be installed between the joists when load bearing walls are located above the bearing point.

F. Engineered Wood Beams
   1. Comply with manufacturer’s written instructions for design, installation, and fastening.
   2. Allowable deflection:
      a. Floor Beams: L360 live load deflection; L240 total load deflection.
      b. Roof Beams: L/180 total load deflection.
   3. Protect wood members from direct contact with concrete or masonry.
4. Refer to manufacturer’s literature for connection of multiple plies of side loaded beams.

END OF SECTION 06 10 00
SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Wall sheathing.
   2. Roof sheathing.
   3. Subflooring

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.
   2. Section 07 27 26 "Fluid-Applied Weather Barriers" for water-resistant barrier applied over wall sheathing.
   3. Section 07 53 23 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for substrate board in membrane roof assembly.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.2 WALL SHEATHING

A. Plywood Sheathing: Exposure 1 sheathing.
   1. Span Rating: Not less than 16/0.
   2. Nominal Thickness: Not less than 15/32 inch.

B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation
      b. Georgia-Pacific Building Products
      c. National Gypsum Company
   2. Type and Thickness: Fire Rated, 1/2 inch thick.

2.3 ROOF SHEATHING

A. Plywood Sheathing: Exterior sheathing.
   1. Span Rating: Not less than 24/0.
   2. Nominal Thickness: Not less than 5/8 inch.

B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation
      b. Georgia-Pacific Building Products
      c. National Gypsum Company
   2. Type and Thickness: Fire Rated, 1/2 inch thick.

2.4 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subfloor: DOC PS 1, Exterior, C-C Plugged single-floor panels.(This is on the gypcrete flooring)
   1. Span Rating: Not less than 16.
   2. Nominal Thickness: Not less than 3/4 inch.
   3. Edge Detail: Tongue and groove.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272

D. Wood Screws: ASME B18.6.1

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

B. Fastening Methods: Fasten panels as indicated below:
   1. Subflooring:
      a. Glue and nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch apart at edges and ends.
   2. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to wood framing with nails.
   2. Fasten gypsum sheathing to cold-formed metal framing with screws.
   4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
   2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
   2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

END OF SECTION 06 16 00
SECTION 064100 – ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. Section Includes:
   1. Architectural wood cabinets.
   2. Plastic laminate faced countertops and windowsills
   3. Shop finishing of architectural wood cabinets
   4. Wood furring, blocking, shims, and hanging strips for installing pre-finished architectural cabinets unless concealed within other construction before cabinet installation.

1.3 SUBMITTALS

A. Product Data: For each type of product, including panel products high-pressure decorative laminate, cabinet hardware and accessories, and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking.

C. Samples:
   1. Shop-applied transparent finish
   2. Plastic laminates, for each color, pattern, and surface finish.
   3. Thermoset decorative panels, for each color, pattern, and surface finish.
   4. PVC edge material.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood Products:
   1. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
2. Industrial Grade Moisture Resistant Medium-Density Fiberboard: ANSI A208.2, Grade 150.

B. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

2.2 ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural pre-finished cabinets indicated for construction, finishes, installation, and other requirements.

1. Interior Woodwork Grade: Custom.

B. Wood Cabinets for Transparent Finish:

1. AWI Type of Cabinet Construction: As indicated on Drawings.
2. Wood for Exposed Surfaces:
   a. Species: Alder
   b. Cut: Plain sliced/plain sawn
   c. Matching Veneer Leaves: Slip match
   d. Veneer Matching within Panel Face: Center-balance.
   e. Veneer Matching within Room: Provide cabinet veneers from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with a continuous match where veneers are interrupted perpendicular to the grain.

5. Drawer Bottoms: Thermoset decorative panels.
6. Colors, Patterns, and Finishes: Formica Corporation; #7197-58 Dover White

C. Plastic-Laminate Countertops – window sills:

1. High-Pressure Decorative Laminate Grade: HGS.
2. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range.
3. Edge Treatment: PVC edge banding.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 120 degrees of opening, self-closing.

1. Grass America Inc.; Model # TIMOS GT310 with insertion machine using 8mm dowels, cabinet member base plate to be Grass model #GT182 applied using 5mm Euro Screws.
C. Drawer Slides: BHMA A156.9, B05091.
   1. Grass America Inc.; Zargen Series Integrated Drawer Side and Slide: Side mounted and extending under bottom edge of drawer; full-extension type.
      a. For standard height drawers use model #6036.
      b. For larger height drawers use model #6136, #6236 or model #6436.
      c. File drawers use model #6036. Provide with #6100 Zargen rails, #6110 Pendaflex File Rail and #6200 full extension member.

D. Countertop Support Brackets:
   1. Federal Brace, Arrowwood Bracket; Model BKT08X08ARS
      a. 2” wide x 8” deep x 8; high
      b. Finish: Stainless Steel

E. Shelf Rests: BHMA A156.9, B04013; metal.
   1. Hardware Resources; 5mm pin, Model #1306BN.
      a. Finish: Polished nickel

F. Grommets: Hardware Concepts; Model # 6740WH

G. Sink and Base Accessories: Provide Rev-A-Shelf; Tip-Out Tray at accessible kitchen units as shown on Drawings.

H. Drawer and Door Pulls: Provide for all cabinets. Basis-of-Design Product: Liberty Hardware; Contempo 5, 1/16” Distressed Bronze Knuckle Cabinet Pull.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.5 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.6 SHOP FINISHING

A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

C. Transparent Finish:

1. Grade: Custom.
2. Base Cabinet Finish:
   a. First Coat: Catalyzed vinyl sealer
   b. Finish Coat: Precatalyzed lacquer.

3. Countertop and Table Top Finish:
   a. First Coat: Catalyzed vinyl sealer
   b. Finish Coat: Conversion varnish

4. Sheen: As approved by Owner/Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

1. Use water resistant particleboard at window sills, toilet room vanity, kitchen sinks and any other high moisture area.

B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.

E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch) penetration into wood framing, blocking, or hanging strips.
F. Touch up finishing work specified in this Section after installation of woodwork.

END OF SECTION 064100
SECTION 064300 - WOOD STAIRS AND RAILINGS

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. Wood stairs and railings, including rough carriages for stairs.

B. Related Sections:
   1. Section 099100 “Interior and Exterior Painting” for field finishing of installed wood stairs and railings.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood stairs and railings until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where wood stairs and railings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where wood stairs and railings are indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD STAIRS AND RAILINGS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

B. Grade: Custom.

C. Wood for Opaque Finish: Any closed-grain hardwood.
2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D 2559, and with the following allowable design values as determined according to ASTM D 5456:
   1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi (17.9 MPa) for 12-inch nominal-depth members.
   2. Modulus of Elasticity, Edgewise: 1,500,000 psi.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.4 FABRICATION

A. Fabricate wood stairs and railings to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Cut carriages to accurately fit treads and risers. Glue treads to risers, and glue and nail treads and risers to carriages.
   1. Fabricate stairs with treads and risers no more than 1/8 inch from indicated position and no more than 1/16 inch out of relative position for adjacent treads and risers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood stairs and railings to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install wood stairs and railings to comply with same grade as item to be installed.

B. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than 1/8 inch from indicated position.
C. Railings:
   1. General: Install rails with no more than 1/8 inch in 96-inch variation from a straight line.
   2. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.

D. Touch up finishing work specified in this Section after installation of wood stairs and railings. Fill nail holes with matching filler where exposed.

END OF SECTION 064300
SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Modified bituminous sheet waterproofing.
   2. Protection Board

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
   2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For each exposed product and for each color and texture specified, including the following products:
   1. 12 by 12 inch square of waterproofing and flashing sheet.
   2. 12 by 12 inch square of protection board.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
   1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.
1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
   1. Warranty includes removing and reinstalling protection board.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials and protection course from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle Coatings & Waterproofing Inc.
      b. Grace Construction Products; W.R. Grace & Co.--Conn.
      c. Tamko Building Products, Inc.
      d. W.R. Meadows, Inc.

   2. Physical Properties:
      a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
      b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
      d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
      e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
      f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
      g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
      h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.


2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
   1. Thickness: 1/8 inch, nominal.
   2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
   1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
   2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
      a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
   1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

E. Seal edges of sheet-waterproofing terminations with mastic.

F. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

H. Immediately install protection course with butted joints over waterproofing membrane.

3.4 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326
SECTION 07 14 00 - FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Hot Fluid-applied, 100% rubber polymer membrane

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
B. Shop Drawings:
   1. Show locations and extent of waterproofing.
   2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
B. Source Limitations for Waterproofing System: All associated products used must be approved in writing by manufacturer in order to maintain applicable warranties.

1.7 WARRANTY
A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubber Polymer Waterproofing Membrane: Spray applied.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Rubber Polymer Corporation; Rub-R-Wall Waterproofing

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing.

B. Primers, Sealants and Accessories: As recommended in writing by manufacturer.

C. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness of 1/4 inch, with compressive strength of not less than 8 psi according to ASTM D 1621 and maximum water absorption by volume of 0.6 percent according to ASTM C 272.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Dow Chemical Company (The).

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.
   1. Repair by standard method using cementitious grout.
   2. Minor surface defect such as entrapped air holes may be repaired with mastic substrate filler.

3.2 MEMBRANE APPLICATION

A. Start application with manufacturer's authorized representative present.

B. Apply membrane and reinforcing in accordance with manufacturer's instructions.
   1. Apply primer on damp surfaces, at manufacturer's recommended rate, over prepared substrate and allow to dry.
2. Apply membrane reinforcing in accordance with manufacturer's instructions. Ensure full bond of membrane to substrate.
3. Using airless spray equipment having a minimum pressure of 3000 psi, apply waterproofing membrane in multiple, uniform passes to provide seamless, monolithic cured membrane of 30-40 mils.
4. Where additional membrane thickness is required allow a minimum cure time between applications of 2-hours.

C. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

D. Install protection course with butted joints over waterproofing, after allowing a cure time of approximately 15 minutes. Waterproofing will be tacky.
   1. Do not overlap protection board.

E. Do not commence backfill earlier than 24 hours after membrane application. Ensure that backfill material is free of debris, organic material, boulders, rocks concrete debris or any other delirious material considered unsuitable fill.

3.3 FIELD QUALITY CONTROL
A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of membrane, flashings, protection, and drainage components; furnish daily reports to Architect.

3.4 CLEANING AND PROTECTION
A. Protect from damage and wear during remainder of construction period.

END OF SECTION 07 14 00
SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Glass-fiber blanket insulation.
   3. Vapor retarders.

B. Related Sections:
   1. Section 07 24 19 "Water-Drainage Exterior Insulation and Finish System (EIFS)" for insulation specified as part of wall assembly.
   2. Section 07 53 23 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

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. CertainTeed Corporation.
   2. Guardian Building Products, Inc.
   5. Owens Corning.
B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.2 MINERAL-WOOL BLANKET INSULATION

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. Industrial Insulation Group, LLC (IIG-LLC).
   2. Johns Manville; a Berkshire Hathaway company.
   3. Roxul Inc.
   4. Thermafiber, Inc.; an Owens Corning company.
   5. USG Interiors Inc.
   6. United States Gypsum Co.

B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.3 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
      2. Gemco; Spindle Type.
   2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. AGM Industries, Inc.; RC150.
   2. Gemco; R-150.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
   1. Ceiling plenums.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. AGM Industries, Inc.; TACTOO Adhesive.
   2. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For wood-framed construction, install blankets according to ASTM C 1320.

3.4 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated.

3.5 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.6 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00
SECTION 07 24 19 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
   1. EIFS-clad water-drainage-wall assemblies over plywood and gypsum board sheathing substrate. Refer to Drawings for locations.

B. Related Requirements:
   1. Section 06 16 00 "Sheathing"
   2. Section 07 27 26 "Fluid-Applied Weather Barriers" for air/weather barrier installed as a part of the water-drainage-wall assembly.

1.3 SYSTEM DESCRIPTION

A. Water-Drainage EIFS: EIFS with a means that allows water entering into an EIFS assembly to drain to the exterior.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and component of EIFS indicated.

B. Shop Drawings: For EIFS. Include plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.

C. Samples for Verification: 24-inch-square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including a typical control joint filled with sealant of color selected.
   1. Include sealants and exposed accessory Samples to verify color selected.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates: Signed by manufacturers certifying that EIFS comply with requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each water-/weather-resistive barrier, insulation, reinforcing mesh, joint sealant, and coating.

D. Field quality-control reports and special inspection reports.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer’s system using trained workers.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1. Stack insulation board flat and off the ground.
2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 FIELD CONDITIONS

A. Weather Limitations: Maintain ambient temperatures above 40 deg F for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, weather-resistant sheathing paper, flashing, trim, joint sealants, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind flashing and drainage plane that is behind water-drainage EIFS.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Bond integrity and weathertightness.
   b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.

2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:
   a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
   b. Insulation installed as part of EIFS.
   c. Insulation adhesive.
   d. EIFS accessories, including trim components and flashing.
   e. Water-resistive coatings.
   f. EIFS drainage components.
3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, Provide Dryvit Systems, Inc.; Outsulation Plus MD System or an approved comparable product by one of the following:
   1. Parex USA Inc.
   2. Senergy; BASF International
   3. Sto Corp.

B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with system components.

2.2 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with the following:
   1. Bond Integrity: Free from bond failure within EIFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
   3. Weathertightness: Resistant to water penetration from exterior into water-drainage EIFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of EIFS and assemblies behind it, including substrates, supporting wall construction, and interior finish, and including a means that allows water entering into an EIFS assembly to drain to the exterior.
   5. Bond Integrity: Free from bond failure within EIFS components or between EIFS and substrates, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
   6. Abrasion Resistance of Finish Coat: Sample consisting of 1-inch-thick EIFS mounted on 1/2-inch- thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to 528 quarts of sand when tested according to ASTM D 968, Method A.
   7. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch clean glass substrate; cured for 28 days and shows no growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274.

2.3 MATERIALS

A. Compatibility: Provide water-resistive coating, adhesive, fasteners, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and with substrates and approved for use by EIFS manufacturer for Project.

B. Primer/Sealer: EIFS manufacturer's standard substrate conditioner, designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.

C. Water-Resistive Coatings: Fluid-applied weather barrier as specified in Section 07 25 00 “Weather Barriers” and approved by EIFS-clad water-drainage-wall manufacturer.
D. Flexible-Membrane Flashing: Cold-applied, fully self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

E. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate.

F. Drainage Mat: Three-dimensional, nonwoven, entangled filament, nylon or plastic Woven or fused, self-furring, PVC mesh lath mat designed to drain incidental moisture by gravity; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate.

G. Spacers: Closed-cell polyethylene Woven or fused, self-furring, PVC mesh lath furring strips; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate.

H. Molded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C 578, Type I; EIFS manufacturer's requirements; and EIMA's "EIMA Guideline Specification for Expanded Polystyrene (EPS) Insulation Board" for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
   1. Dimensions: Provide insulation boards not more than 24 by 48 inches and in thickness indicated but not more than 4 inches thick or less than thickness allowed by ASTM C 1397.
   2. Board Insulation Closure Blocks: EIFS manufacturer's standard density, size, and configuration.
   3. Foam Shapes: Provide with profiles and dimensions indicated on Drawings.

I. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. per ASTM E 2098; complying with ASTM D 578 and the following:
   1. Standard-Impact Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
   2. Strip Reinforcing Mesh: Not less than 3.75 oz./sq. yd.
   3. Detail Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
   4. Corner Reinforcing Mesh: Not less than 7.2 oz./sq. yd.

J. Base-Coat Materials: EIFS manufacturer's standard mixture complying with the following requirements:
   1. Job-mixed formulation of portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.

K. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

L. Finish-Coat Materials: EIFS manufacturer's standard acrylic-based coating complying with the following:
   1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
2. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
3. Colors: As selected by Architect from manufacturer's full range.

M. Water: Potable.

N. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard Cell Class for use intended, and ASTM C 1063.

2.4 MIXING

A. General: Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of EIFS.

B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.

C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 EIFS INSTALLATION

A. Comply with ASTM C 1397, ASTM E 2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

B. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.

C. Board Insulation: Adhere insulation to substrate in compliance with ASTM C 1397 and the following:
1. Apply adhesive to insulation by notched-trowel method, with notches oriented vertically to produce drainage channels that remain functional after the insulation is adhered to substrate.

2. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier.

D. Expansion Joints: Install at locations indicated and where required by EIFS manufacturer.

E. Waterproof Adhesive/Base Coat: To exposed surfaces of insulation, apply in minimum thickness recommended in writing by EIFS manufacturer over sloped surfaces, windowsills, and parapets.

F. Base Coat: Apply to exposed surfaces of insulation in minimum thickness recommended in writing by EIFS manufacturer.

G. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

H. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions in same manner as first application. Do not apply until first base coat has cured.

I. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings, extending 4 inches beyond perimeter. Apply additional 9-by-12-inch strip reinforcing mesh diagonally at corners of openings (re-entrant(5,7),(995,988)(5,7),(995,988)). Apply 8-inch- wide, strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches on each side of corners.

J. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

K. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.

L. Finish Coat: Apply over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. EIFS Tests and Inspections: For the following:

C. Remove and replace EIFS where test results indicate that EIFS do not comply with specified requirements.

D. Prepare test and inspection reports.
3.5 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

END OF SECTION 07 24 19
SECTION 07 27 26 - FLUID-APPLIED WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. General provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY
A. Section includes fluid-applied, vapor-retarding membrane weather barriers.
B. Related Requirements:
   1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
   2. Section 07 24 19 "Water-Drainage Exterior Insulation and Finish System (EIFS)"

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.
   1. Review air-barrier requirements and installation, special details, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
B. Shop Drawings: For air-barrier assemblies.
   1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   2. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.
B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Source Limitations: Obtain primary weather-barrier materials and weather-barrier accessories from single source from single manufacturer.

1.7 FIELD CONDITIONS
A. Environmental Limitations: Apply weather barrier within the range of ambient and substrate temperatures recommended by weather-barrier manufacturer.
   1. Protect substrates from environmental conditions that affect weather-barrier performance.
   2. Do not apply weather barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.8 WARRANTY
A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for weather barrier that does not meet specified water and air hold-out criteria.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LOW-BUILD AIR-BARRIERS, VAPOR-RETARDING MEMBRANES
A. Low-Build, Vapor-Retarding Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils over smooth, void-free substrates.
   1. Synthetic Polymer:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide Dryvit Systems, Inc.; Backstop NT or an approved comparable product.

B. Physical and Performance Properties:
   1. Air Permeance: Maximum: 0.00012 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   2. Water Vapor Transmission: Maximum 7.9 perms; ASTM E 96 Procedure B.
   3. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84.
      a. Flame Spread less than 25
      b. Smoke Developed less than 450
   4. UV Resistance: Can be exposed to sunlight for 120 hours according to manufacturer's written instructions.

2.2 ACCESSORY MATERIALS
A. General: Accessory materials recommended by weather-barrier manufacturer to produce a complete weather-barrier assembly and compatible with primary weather-barrier material.

B. Joint Tape: Manufacturer's recommended glass-fiber-mesh tape.

C. Flashing for use around openings in walls and joints between different building materials: Manufacturer's recommended fluid-applied polymer material and flexible flashing with butyl adhesive layer.
   1. Sheet flashing shall be used at transitions between wall material, building corners, and over gaps in sheathing up to 1-inch wide.
D. Sealant: Weather-barrier manufacturer's elastomeric permeable sealant; compatible with weather barrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete surface preparation, priming, flashing and detailing of openings, cracks, and material transitions prior to beginning installation of fluid-applied weather barrier system.

3.3 JOINT TREATMENT

A. General: Install fluid-applied membrane and accessory materials according to weather-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Sheathing Joints:

1. No joint treatment is required for joints up to 1/16-inch
2. Joints 1/16" to 1/4": Cover with fluid-applied joint compound and trowel smooth
3. Joints 1/4" to 1/2": Apply joint tape to bridge both sides of joint equally. Cover with fluid-applied joint compound and trowel smooth.
4. Joints 1/2" to 1-inch: Apply sheet flashing primer above and below joint. Center sheet flashing over joint and press into place per manufacturer’s recommendations.

C. Wall Openings:

1. Jambs and Heads: Install fluid-applied elastomeric flashing at openings for full depth of opening and 2-inches onto the outside face of opening.
2. Sills: Apply primer to substrate. Apply flashing so that a minimum of 2 inches of coverage is achieved over each substrate.

D. Allow fluid-applied flashing, joint compound and sealant to cure for a minimum of 24 hours before coating with weather barrier.

3.4 FLUID AIR-BARRIER, VAPOR RETARDER MEMBRANE INSTALLATION

A. General: Apply fluid weather-barrier material to form a seal with strips and transition strips and to achieve a continuous weather barrier according to weather-barrier manufacturer's written instructions. Apply fluid weather-barrier material within manufacturer's recommended application temperature ranges.

B. Install fluid-applied weather barrier prior to installation of windows, doors and louvers.
C. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

D. Install weather barrier by power-rolling method in a single coat to achieve a consistent and uniform dry film thickness as recommended by manufacturer.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

END OF SECTION 07 27 26
SECTION 073113 - ASPHALT SHINGLES

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. Asphalt shingles.
   2. Underlayment.
   3. Ridge vents.
   4. Metal Flashing and Trim

B. Related Requirements:
   1. Section 061600 "Sheathing" for roof sheathing.
   2. Section 077100 “Roof Specialties”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For each exposed product and for each color and texture specified.
C. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
   1. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first three years nonprorated.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Roofing Corporation.
      b. GAF Materials Corporation.
c. Tamko Building Products, Inc.

2. Strip Size: Manufacturer's standard.
4. Color and Blends: As selected by Architect from manufacturer's full range.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 UNDERLAYMENT MATERIALS

   1. Type: Type I.


2.3 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips for use under ridge shingles.

B. Basis of design: Cor-A-Vent Products “V-600E,11” providing 20 sq. in./LF free area with integral non-woven filter enhanced snow screen.

2.4 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-diameter, sharp-pointed, with a minimum 3/8-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.
   1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

D. Attic Rafter Vent: Extruded polystyrene foam extrusions sized to fit between rafters.
   1. Provide Owens Corning; Raft-R-Mate Attic Rafter Vents or an approved comparable product.

2.5 METAL FLASHING AND TRIM

A. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
   2. Apron Flashings: Fabricate with lower flange a minimum of 5 inches over and 5 inches beyond each side of downslope asphalt shingles and 5 inches up the vertical surface.
3. Step Flashings: Fabricate with a headlap of 2 inches and a minimum extension of 5 inches over the underlying asphalt shingle and up the vertical surface.

4. Cricket or Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches beneath upslope asphalt shingles and 6 inches beyond each side of chimney and 6 inches above the roof plane.

5. Open-Valley Flashings: Fabricate in lengths not exceeding 10 feet with 1-inch-high, inverted-V profile at center of valley and equal flange widths of 12 inches.


B. Vent Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Ice and Water Shield:
   1. Install across eave, making sure to overlap the leading edge with the top of the drip edge.
   2. Install a second course overlapping minimum 3-inches over the first course.
   3. Install across any valley, running 18-inches on either side of the valley.
   4. Install minimum 4-inches up any walls that intersect with roof edges.

C. Single-Layer Felt Underlayment (Slopes greater than 4:12): Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails.
   1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction that sheds water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.
   2. Install fasteners at no more than 36 inches o.c.

D. Double-Layer Felt Underlayment (Slope between 3:12 and 4:12): Install on roof deck parallel with and starting at the eaves. Install a 19-inch- wide starter course at eaves and completely cover with full-width second course. Install succeeding courses lapping previous courses 19 inches in shingle fashion. Lap ends a minimum of 6 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with roofing nails.
   1. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches in direction that sheds water.
   2. Terminate felt underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.
   3. Install fasteners at no more than 36 inch o.c.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

3.3 ASPHALT-SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.
   1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

F. Fasten asphalt-shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.
   1. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
   2. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.

G. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips. Widen exposed portion of open valley 1/8 inch in 12 inches (1:96) from highest to lowest point.
   1. Set valley edge of asphalt shingles in a 3-inch-wide bed of asphalt roofing cement.
   2. Do not nail asphalt shingles to metal open-valley flashings.

H. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

I. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
   1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 073113
SECTION 07 4646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Fiber-cement siding and trim.
   2. Prefinished flashing

B. Related Requirements:
   1. Section 06 1600 "Sheathing" for sheathing joint and penetration treatment.
   2. Section 07 2500 "Weather Barriers" for sheet air barrier applied over wall sheathing.
   3. Section 09 99113 "Exterior Painting"

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each fiber-cement product including related accessories.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 WARRANTY

A. Product Warranty: Manufacturer's limited, non-pro-rated product warranty.
   1. Warranty Period for Artisan HZ10 lap siding boards - 30 years from date of Substantial Completion.
   2. Warranty Period for Trim – Hardie Trim HZ and HZ10: 15 years from date of Substantial Completion.
   3. Workmanship: Application limited for 2-years.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of design – Hardie Trim HZ10 and Hardie HZ boards as manufactured by James Hardie Building Products, Inc.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 AUXILIARY MATERIALS

A. Joint Sealant: Manufacturer's recommended sealant complying with ASTM C 920.

B. Basis-of-Design Product: Subject to compliance with requirements provide Henkel Corporation; OSI QUAD or comparable product approved by the manufacturer.

1. Type and Grade: S (single component) and NS (nonsag)
2. Class: 25
3. Use Related to Exposure: NT (nontraffic)
4. Stain-Test-Response Characteristics: Nonstaining to concrete and masonry, including brick per ASTM C 510.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

B. Aluminum Sheet Flashing: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. ALSCO Coated Finish (Contractor's Option):
   b. Striated PVC

2. Color: As selected by Owner from manufacturer's full range.

C. Fasteners: Use coated aluminum, hot-dip galvanized or stainless steel fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.
B. Siding Installation:

1. Allow for vertical clearance between the edge of the siding and any other material.
2. Align vertical joints of the planks over framing members.
3. Install fasteners no closer than 3/8-inch from panel edge and 2-inches from panel corners.
4. Locate splices at least 12-inches away from window and door openings.

C. Trim Installation:

1. Place fastener no closer than 3/4-inch and no further than 2-inches from side edge of trim board and no closer than 1-inch from end.
2. Fasten maximum 16-inches on center.
4. Fasten through overlapping boards. Do not nail between lap joints.
5. Fasten trim at soffit expansion joint through slotted holes.

D. Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer's printed instructions.

E. Install joint sealants as specified in Section 07 9200 "Joint Sealants" and to produce a weathertight installation.

3.2 FINISHING

A. Finish factory primed siding within 180 days of installation.

3.3 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 4646
SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

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. Formed Products:
      a. Formed roof drainage sheet metal fabrications.
      b. Formed low-slope roof sheet metal fabrications.
      c. Formed equipment support flashing.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
   1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft.: 90-lbf/sq. ft. perimeter uplift force, 120-lbf/sq. ft. corner uplift force, and 45-lbf/sq. ft. outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

2. Surface: Smooth, flat.

3. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

4. Color: As selected by Architect from manufacturers full range.

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 UNDERLAYMENT MATERIALS


B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal
flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

G. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions.
   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. Fry Reglet Corporation.
      b. Heckmann Building Products Inc.
      c. Hickman, W. P. Company.
   2. Material: Galvanized steel, 0.022 inch thick.
   3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Finish: Mill.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

F. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Fabricate from the following materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Butt, with 12-inch-wide, concealed backup plate.
2. Fabricate from the following materials:
   a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.

B. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch thick.

C. Base Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
D. Counterflashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

E. Flashing Receivers: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

G. Roof-Drain Flashing: Fabricate from the following materials:
   1. Copper: 12 oz./sq. ft.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.

C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
   1. Coat back side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.
   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

F. Rivets: Rivet joints where necessary for strength.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
   1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
   2. Loosely lock front edge of scupper with conductor head.
3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

C. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper discharge.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
   2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00
SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.
B. Related Sections:
   1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
   2. Division 07 Section "Expansion Control" for building expansion joints.
   3. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
   4. Division 08 Section "Glazing" for glazing sealants.
   5. Division 09 Section "Gypsum Board" for sealing perimeter joints.
   6. Division 09 Section "Tiling" for sealing tile joints.
   7. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 SUBMITTALS
A. Product Data: For each joint-sealant product indicated.
B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
C. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

   B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Twenty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 799.
      b. Pecora Corporation; 898.
      c. Tremco Incorporated; Tremsil 600 White.
2.3 URETHANE JOINT SEALANTS
   A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Pecora Corporation; Dynatrol II.
         b. Polymeric Systems, Inc.; PSI-270.
         c. Tremco Incorporated; Dymeric 511.

2.4 LATEX JOINT SEALANTS
   A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
      1. Products: Subject to compliance with requirements, provide one of the following:
         b. Tremco Incorporated; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS
   A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Pecora Corporation; AC-20 FTR.
         b. USG Corporation; SHEETROCK Acoustical Sealant.

2.6 JOINT SEALANT BACKING
   A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
   C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS
   A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
   B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
   4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage
or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

   1. Joint Locations:
      a. Control and expansion joints in unit masonry.
      b. Joints in exterior insulation and finish systems.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of doors windows and louvers.
      e. Control and expansion joints in ceilings and other overhead surfaces.
      f. Other joints as indicated.
   4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
      f. Other joints as indicated.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints where indicated.
      c. Other joints as indicated.
   2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

   1. Joint Location:
      a. Acoustical joints where indicated.
      b. Other joints as indicated.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00
SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Standard hollow metal doors and frames.

B. Related Sections:
   1. Section 08 71 00 "Door Hardware (Scheduled by Describing Products)" for door hardware for hollow metal doors.
   2. Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for field painting hollow metal doors and frames.
   3. Section 09 91 23 "Interior Painting" for field painting flush wood doors.
   4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
   8. Details of moldings, removable stops, and glazing.
   9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1.9 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld International, LLC.
2. Ceco Door Products; an Assa Abloy Group company.
3. Curries Company; an Assa Abloy Group company.
4. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.
2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR FRAMES

A. Heavy-Duty Frames: SDI A250.8, Level 2.
   1. Physical Performance: Level B according to SDI A250.4.
   2. Frames:
      a. Materials: Uncoated, steel sheet, minimum thickness of 16 gauge (0.053 inch)
      b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
      c. Construction: Full profile welded.
      d. Exposed Finish: Manufacturer’s standard primer in accordance with SDI A250.10.

2.4 EXTERIOR DOORS AND FRAMES

A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
   1. Physical Performance: Level B according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      c. Face: Metallic-coated steel sheet, minimum thickness of 18 gauge (0.042 inch), with minimum A40 (ZF120) coating.
      d. Edge Construction: Model 2, Seamless.
      e. Core: Polyurethane.
   3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
   4. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 16 gauge (0.053 inch), with minimum A40 (ZF120) coating.
      b. Construction: Full profile welded.
   5. Exposed Finish: Manufacturer’s standard primer in accordance with SDI A250.10.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 18 gauge (0.042 inch) thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 18 gauge (0.042) inch thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 18 gauge (0.042 inch), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 08 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 STOPS AND MOLDINGS

A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

B. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.
2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   6. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
         1) Two anchors per jamb up to 60 inches high.
         2) Three anchors per jamb from 60 to 90 inches high.
         3) Four anchors per jamb from 90 to 120 inches high.
         4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
      b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.
         4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
   7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

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

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

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow metal work.
4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES

A. Prime Finish: Apply manufacturer’s standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer’s standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer’s written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

      a. At fire-protection-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

6. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

      a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

   1. Non-Fire-Rated Standard Steel Doors:

      a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 13
SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Solid-core doors with wood-veneer, hardboard or MDF faces.
      2. Hollow-core doors with wood-veneer, hardboard or MDF faces.
      3. Shop priming flush wood doors.
      4. Factory fitting flush wood doors to frames and factory machining for hardware.
   B. Related Requirements:
      1. Section 088000 "Glazing" for glass view panels in flush wood doors.
      2. Section 099113 "Interior Painting" for field finishing doors.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of door. Include details of core and edge construction and trim for openings.
   B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
      1. Dimensions and locations of blocking.
      2. Dimensions and locations of mortises and holes for hardware.
      3. Dimensions and locations of cutouts.
      4. Undercuts.
      5. Fire-protection ratings for fire-rated doors.
   C. Samples for Verification:
      1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
      2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS
   A. Sample Warranty: For special warranty.
   B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING
A. Comply with requirements of referenced standard and manufacturer's written instructions.
B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS
A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY
A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Algoma Hardwoods, Inc.
   2. Eggers Industries.
   3. Graham Wood Doors; ASSA ABLOY Group company.
   4. Mohawk Flush Doors, Inc.
   5. VT Industries Inc.
B. Source Limitations: Obtain flush wood doors from single manufacturer.
2.2 **FLUSH WOOD DOORS, GENERAL**  

A. **Quality Standard:** In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. **WDMA I.S.1-A Performance Grade:**

1. Heavy Duty unless otherwise indicated.

C. **Smoke- and Draft-Control Door Assemblies:** Listed and labeled for smoke and draft control, based on testing according to UL 1784.

2.3 **DOORS FOR OPAQUE FINISH**

A. **Interior Solid-Core Doors:**

1. Grade: Stain grade Premium.
2. Faces: Hardboard.
   
   a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
4. Core: Particleboard, glued wood stave or structural composite lumber.
5. Construction: Three plies, either bonded or nonbonded.
6. **WDMA I.S.1-A Performance Grade:** Heavy Duty.

2.4 **FABRICATION**

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. **Metal Astragals:** Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Opaque Finish:

1. Grade: Premium.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish.
4. Color: As selected by Architect from manufacturer's full range.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
   a. Comply with NFPA 80 for fire-rated doors.
   b. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416
SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Detail fabrication and installation of access doors and frames for each type of substrate.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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. Babcock-Davis.
   4. Milcor Inc.
   5. Nystrom, Inc.

B. Flush Access Doors with Exposed Flanges:
   1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
   2. Locations: Wall and ceiling.
   3. Door Size: As indicated on drawings or as necessary for application.
   4. Uncoated Steel Sheet for Door: Nominal, 16 gage.

C. Hardware:
   1. Latch: Cam latch operated by screwdriver.

2.2 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
   2. Provide mounting holes in frames for attachment of units to metal or wood framing.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

   A. Comply with manufacturer's written instructions for installing access doors and frames.

   B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

   A. Adjust doors and hardware, after installation, for proper operation.

   B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13
SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Exterior and interior storefront framing.
   2. Storefront framing for punched openings.
   3. Exterior and interior manual-swing entrance doors and door-frame units.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

   1. Dimensional tolerances of building frame and other adjacent construction.
   2. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Glazing-to-glazing contact.
      e. Noise or vibration created by wind and by thermal and structural movements.
      f. Loosening or weakening of fasteners, attachments, and other components.
      g. Sealant failure.
      h. Failure of operating units.

B. Structural Loads:

   1. Wind Loads:
      a. Basic Wind Speed: 90 mph.

C. Deflection of Framing Members:

   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.
D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

G. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Welding certificates.

F. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

G. Warranties: Sample of special warranties.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

C. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Adhesive or cohesive sealant failures.
   e. Water leakage through fixed glazing and framing areas.
   f. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Arch Aluminum & Glass Co., Inc.
2. Commercial Architectural Products, Inc.
3. EFCO Corporation.
4. Kawneer North America; an Alcoa company.
5. TRACO.
6. Tubelite.
7. Manko..
2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   4. Structural Profiles: ASTM B 308/B 308M.
   5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
D. Bond-Breaker Tape: Manufacturer’s standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer’s standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
      a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
   2. Door Design: Wide stile; 5-inch nominal width.
      a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
      a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
   1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers’ products.
   2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
   3. Opening-Force Requirements:
      a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
      b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

B. Opening-Force Requirements:
   1. Latches and Exit Devices: Not more than 15 lbf required to release latch.

C. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
   1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
   2. Exterior Hinges: Stainless steel, with stainless-steel pin.
   3. Quantities:
      a. For doors up to 87 inches high, provide 3 hinges per leaf.

D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

F. Cylinders: BHMA A156.5, Grade 1.
1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".

G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

H. Operating Trim: BHMA A156.6.

I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.

J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

K. Weather Stripping: Manufacturer's standard replaceable components.
   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

M. Silencers: BHMA A156.16, Grade 1.

N. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

O. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

C. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

E. Install glazing as specified in Division 08 Section "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 08 41 13
SECTION 08553 (08 52 13) - ALUMINUM-CLAD WOOD FIXED-FRAME WINDOWS

PART 1  GENERAL

1.1  SECTION INCLUDES

A. Aluminum-clad wood fixed-frame windows.

1.2  RELATED SECTIONS

A. Section 07920 (07 92 00) - Joint Sealants:  Sealants and caulking.

1.3  REFERENCES

A. American Architectural Manufacturers Association (AAMA):

B. American Society for Testing and Materials (ASTM):
   2. ASTM C 1036 - Flat Glass.
   3. ASTM C 1048 - Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.
   4. ASTM D 1149 - Rubber Deterioration – Surface Ozone Cracking in a Chamber.
   6. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
   8. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.

C. Window and Door Manufacturers Association (WDMA):
   1. ANSI/AAMA/NWWDA 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
   3. WDMA I.S.4 - Industry Standard for Water-Repellent Preservative Non-Pressure Treatment for Millwork.

1.4  PERFORMANCE REQUIREMENTS

A. Windows shall be Hallmark certified to a rating of FW-[AW] [CW]-PG[____ ] specifications in accordance with ANSI/AAMA/NWWDA 101/I.S.2/A440-08 or ANSI/AAMA/NWWDA 101/I.S.2/A440-11.

B. Window Unit Air Leakage, ASTM E 283, 6.24 psf (50 mph):  0.05 cfm per square foot of frame or less.

C. Window Unit Water Penetration:  No water penetration through window unit when tested in accordance with ASTM E 547, under static pressure of 14.2 psf (75 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 5 gallons per hour per square foot.
1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, including installation instructions.

C. Shop Drawings: Submit manufacturer’s shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details.

D. Samples: Submit full-size or partial full-size sample of window illustrating glazing system, quality of construction, and color of finish.

E. Warranty: Submit manufacturer’s standard warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site undamaged in manufacturer’s or sales branch’s original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.

B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website www.pella.com.

2.2 ALUMINUM-CLAD WOOD FIXED-FRAME WINDOWS


B. Frame:
1. Select woods, water-repellent, preservative-treated with EnduraGuard® in accordance with WDMA I.S.-4. EnduraGuard includes water-repellency, three active fungicides and an insecticide applied to the frame.
2. Interior Exposed Surfaces: Clear Pine with no visible fastener holes.
4. Assembled with screws and concealed corner locks.
5. Overall Frame Depth: 5 inches (127 mm).

2.3 GLAZING

A. Glazing:
2.5 TOLERANCES

A. Windows shall accommodate the following opening tolerances:
   1. Vertical Dimensions Between High and Low Points: Plus 1/4 inch, minus 0 inch.
   2. Width Dimensions: Plus 1/4 inch, minus 0 inch.
   3. Building Columns or Masonry Openings: Plus or minus 1/4 inch from plumb.

2.6 FINISH

   1. Exterior aluminum surfaces shall be finished with the following multi-stage system:
      a. Clean and etch aluminum surface of oxides.
      b. Pre-treat with conversion coating.
      c. Top coat with baked-on polyester enamel.
   2. Color: Selected from Manufacturer’s standard colors.
   3. Performance Requirements: Exterior aluminum finishes shall meet or exceed the following performance requirements of AAMA 2605:
      a. Dry Film Hardness: Eagle Turquoise Pencil, F minimum.
      b. Film Adhesion: 1/16-inch crosshatch, dry, wet, boiling water.
      d. Abrasion Resistance: Falling sand coefficient value of 20 minimum.
      e. Chemical Resistance: 10 percent Muriatic acid, 15 minutes. Mortar pat test, 24 hours.
      f. Detergent Resistance: 3 percent at 100 degrees F, 72 hours.
      g. Corrosion Resistance: Humidity, 3,000 hours. Salt spray exceeds 3,000 hours.


2.7 INSTALLATION ACCESSORIES

A. Flashing/Sealant Tape: Pella SmartFlash.
   1. Aluminum-foil-backed butyl window and door flashing tape.
   2. Maximum Total Thickness: 0.013 inch.
   3. UV resistant.
   4. Verify sealant compatibility with sealant manufacturer.

B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure polyurethane insulating window and door foam sealant.

C. Exterior Perimeter Sealant: “Pella Window and Door Installation Sealant” or equivalent high quality, multi-purpose sealant as specified in the joints sealant section.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION
A. Install windows in accordance with manufacturer's instructions and approved shop drawings.

B. Install windows to be weather-tight and freely operating.

C. Maintain alignment with adjacent work.

D. Secure assembly to framed openings, plumb and square, without distortion.

D. Integrate window system installation with exterior weather-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with weather-resistant barrier using watershed principles in accordance with window manufacturer's instructions.

F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using [backer rod and sealant] [insulating-foam sealant].

G. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.

3.3 FIELD QUALITY CONTROL

A. Field Testing: Field-test windows in accordance with AAMA 502, Test Method A. Manufacturer's representative shall be present.

3.4 CLEANING

A. Clean window frames and glass in accordance with Division 1 requirements.

B. Do not use harsh cleaning materials or methods that would damage finish.

C. Remove labels and visible markings.

3.5 PROTECTION

A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

END OF SECTION
SECTION 08 71 00 - DOOR HARDWARE

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. Mechanical door hardware for the following:
      a. Swinging doors.

B. Related Sections:
   1. Section 08 11 13 "Hollow Metal Doors and Frames".
   2. Section 08 14 16 "Flush Wood Doors"
   3. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" for entrance door
      hardware.
   4. Section 08 42 29 "Automatic Entrances" for entrance door hardware.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details,
   material descriptions, dimensions of individual components and profiles, and finishes.

B. Other Action Submittals:
   1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing
      fabrication and assembly of door hardware, as well as installation procedures and
      diagrams. Coordinate final door hardware schedule with doors, frames, and related work
      to ensure proper size, thickness, hand, function, and finish of door hardware.
      a. Submittal Sequence: Submit door hardware schedule concurrent with
         submissions of Product Data. Coordinate submission of door hardware schedule
         with scheduling requirements of other work to facilitate the fabrication of other work
         that is critical in Project construction schedule.
      b. Format: Use same scheduling sequence and format and use same door numbers
         as in the Contract Documents.
      c. Content: Include the following information:
         1) Identification number, location, hand, fire rating, size, and material of each
            door and frame.
         2) Locations of each door hardware set, cross-referenced to Drawings on floor
            plans and to door and frame schedule.
         3) Complete designations, including name and manufacturer, type, style,
            function, size, quantity, function, and finish of each door hardware product.
         4) Fastenings and other pertinent information.
         5) Explanation of abbreviations, symbols, and codes contained in schedule.
         6) Mounting locations for door hardware.
         7) List of related door devices specified in other Sections for each door and
            frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

C. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
   1. Warehousing Facilities: In Project's vicinity.
   2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
   1. For door hardware, an Architectural Hardware Consultant (AHC).

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
   1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
   2. Comply with the following maximum opening-force requirements:
      a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
   3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high and 3/4 inch high for exterior sliding doors.
   4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

F. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
   1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   2. Preliminary key system schematic diagram.
   3. Requirements for key control system.
4. Requirements for access control.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.6 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of doors and door hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

   2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

      a. Exit Devices: Two years from date of Substantial Completion.
      b. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.
PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA designations referenced.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

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. Hager Companies.
   b. Lawrence Hardware Inc.
   c. McKinney Products Company; an ASSA ABLOY Group company.
   d. Stanley Commercial Hardware; Div. of The Stanley Works.
   e. Stanley Commercial Hardware; Div. of The Stanley Works.

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

   1. Bored Locks: Minimum 1/2-inch latchbolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

   1. Description: As indicated on Drawings.
   2. Levers: Wrought or forged.
   4. Dummy Trim: Match lever lock trim and escutcheons.
   5. Operating Device: Lever with escutcheons (roses).

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

   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. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company.
b. Falcon Lock; An Ingersoll-Rand Company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
d. Schlage Commercial Lock Division; an Ingersoll-Rand company.

2.4 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.5: Grade 1; with strike that suits frame.
   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. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company.
      b. Falcon Lock; an Ingersoll-Rand company.
      c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
      d. Schlage Commercial Lock Division; an Ingersoll-Rand company.

B. Push-Button Combination Locks: BHMA A156.5; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.
   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. Kaba Ilco Corp.; a Kaba Group company.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.
   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:
      b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company.
      c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
      d. Von Duprin; an Ingersoll-Rand company.

2.6 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
   1. Manufacturer: Same manufacturer as for locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.7 KEYING

   1. Master Key System: Change keys and a master key operate cylinders.
B. Keys: Nickel silver.
   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
      a. Notation: "DO NOT DUPLICATE."
   2. Quantity: In addition to one extra key blank for each lock, provide the following:

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

   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. LCN Closers; an Ingersoll-Rand company.
      b. Norton Door Controls; an ASSA ABLOY Group company.

2.9 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

   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. National Guard Products.
      b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
      c. Reese Enterprises, Inc.
      d. Zero International.

2.10 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

   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. National Guard Products.
      b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
      c. Reese Enterprises, Inc.
      d. Zero International.
2.11 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

   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. Baldwin Hardware Corporation.
      b. IVES Hardware; an Ingersoll-Rand company.
      c. Rockwood Manufacturing Company.

2.12 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

   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. Baldwin Hardware Corporation.
      b. Hager Companies.
      c. Rockwood Manufacturing Company.
      d. Stanley Commercial Hardware; Div. of The Stanley Works.

2.13 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

   1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

   1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

   2. Fire-Rated Applications:
      a. Wood or Machine Screws: For the following:
         1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
         2) Strike plates to frames.
         3) Closers to doors and frames.
b. Steel Through Bolts: For the following unless door blocking is provided:
   1) Surface hinges to doors.
   2) Closers to doors and frames.
   3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   2. Custom Steel Doors and Frames: HMMA 831.
B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

F. Stops: Provide wall stops for doors.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.
C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 08 71 00
SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Storefront framing.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer’s written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

E. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than
thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. **Glass Thicknesses:** Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
   a. Specified Design Wind Loads: 110 mph, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."

C. **Thermal and Optical Performance Properties:** Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
   1. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch- (12.7-mm-) wide interspace.
   2. **Center-of-Glass Values:** Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
      a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).

1.5 **SUBMITTALS**

A. **Product Data:** For each glass product and glazing material indicated.

B. **Warranties:** Special warranties specified in this Section.

1.6 **QUALITY ASSURANCE**

A. **Installer Qualifications:** An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. **Source Limitations for Glass:** Obtain the following through one source from a single manufacturer for each glass type: insulating glass.

C. **Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings:** Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. **Source Limitations for Glazing Accessories:** Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. **Safety Glazing Products:** Comply with testing requirements in 16 CFR 1201.

   1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council acceptable to authorities having jurisdiction.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Product: Subject to compliance with requirements, provide product specified.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
6. Basis-of-Design Product: The design for each glazing product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 GLASS PRODUCTS

A. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal, with primary and secondary sealants as follows:
a. Manufacturer's standard sealants.

4. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

2. EPDM, ASTM C 864.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.5 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.6 INSULATING-GLASS UNITS

A. Clear Insulating-Glass Units:
1. Subject to compliance with requirements, Manufacturer’s that may be used for each type of glass:

2. Overall Unit Thickness and Thickness of Each Lite: 1”, 2 layers of ¼” clear glass on each side of ½” gas filled space with –20 degrees F dew point and Class A sealant type edge construction to maintain hermetic seal. Exterior storefront glazing shall have low-E coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000
SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Exterior gypsum board for ceilings and soffits.
   3. Tile backing panels.
   4. Texture finishes.

B. Related Requirements:
   1. Section 09 22 16 "Non-Structural Metal Framing"

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Gypsum.
   2. CertainTeed Corp.
   3. Georgia-Pacific Gypsum LLC.
   4. Lafarge North America Inc.
   6. Temple-Inland.
   7. USG Corporation.

B. Moisture-and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
   2. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Gypsum.
      b. CertainTeed Corp.
      c. Georgia-Pacific Gypsum LLC.
      d. Lafarge North America Inc.
      e. PABCO Gypsum.
      f. Temple-Inland.
      g. USG Corporation.
   2. Core: 5/8 inch.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.
   5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:
   1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
   2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:
   1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
   b. Grabber Construction Products; Acoustical Sealant GSC.
   c. Pecora Corporation; AC-20 FTR.
   e. USG Corporation; SHEETROCK Acoustical Sealant.

F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

2.8 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.

1. Products: Subject to compliance with requirements, provide one of the following:
   b. USG Corporation; BEADEX FasTex Wall and Ceiling Spray Texture.

2. Texture: Spatter knock-down.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Vertical and ceiling surfaces unless otherwise indicated.
   2. Moisture- and Mold-Resistant Type: As indicated on Drawings.
   3. Glass-Mat Interior Type: As indicated on Drawings.
   4. Skim-Coated Type: As indicated on Drawings.

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      b. At high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
   3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
3.4 APPLYING TILE BACKING PANELS

A. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. LC-Bead: Use at exposed panel edges.
   3. L-Bead: Use where indicated.
   4. U-Bead: Use at exposed panel edges.

D. Exterior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. LC-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

3.7 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00
SECTION 09 9000 - INTERIOR AND EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes surface preparation and the application of paint systems on the following substrates:
      1. Gypsum board – ceilings and walls
      2. Wood doors
      3. Fiber-Cement Siding
      4. Concrete masonry units (cmu)
      5. Hollow metal doors and frames
   B. Related Sections:
      1. Section 03 3000 “Cast-In-Place Concrete” for sealer on exposed concrete floor slabs.

1.2 SUBMITTALS
   A. Product Data: For each paint system specified. Include block filler and primers.
      1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
      2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   B. Samples: For each finish and for each color and texture required.

1.3 EXTRA MATERIALS
   A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
      1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 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. Manufacturers: Subject to compliance with requirements, and prior approval by the Architect, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Benjamin Moore & Co. (Moore)
   b. Kwal Paint (Kwal)
   c. PPG Industries, Inc. (PPG)
   d. The Sherwin-Williams Company (S-W)

C. Colors: As indicated in the Material Color Schedule and as approved by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent
   2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrate of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Ferrous Metals: Rust and other surface contaminants must be removed. Touch up shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
3. Galvanized Surfaces: Solvent clean per SSPC-SP1 to remove grease and oil. If any oxidation (white rust) has formed, sand and remove all forms of contamination. If the galvanized has been passivated or stabilized, the surface must be abraded per SSPC-SP7 or chemically treat the surface.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer’s written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.
2. Paint visible electrical and mechanical components that are not concealed from view to match adjacent surfaces.
3. Paint access panels, registers, ducts, exposed piping, exposed insulated pipes, electrical conduits, surface raceways, electrical boxes and all other electrical and mechanical components unless the Architect rules the existing finish satisfactory.
4. Mechanical and electrical components with finishes of brass, copper, or stainless steel are not to be painted.
5. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
6. Provide finish coats that are compatible with primers used.
7. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
8. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
9. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer on metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING AND PROTECTION

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting.
3.5 INTERIOR PAINTING SCHEDULE

A. Gypsum Board Substrates:

   a. Primer: Alkali-resistant, alkyd- or latex-based, interior primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
      1) S-W: ProMar 200 Interior Latex Wall Primer B28W8200.
   b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
      1) SW: ProMar 200 Latex Low-Sheen ES Enamel B20-2600 Series.

2. Flat, Latex System on ceilings - Gloss Level 1: Two coats over a primer.
   a. Primer: Alkali-resistant, alkyd- or latex-based, interior primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
   b. First and Second Coats: Flat, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
      1) SW: Duration Home Int. Latex Matte

B. Wood Substrates:

1. Alkyd System on running trim: Two finish coats over a wood primer.
   Prime Coat: Alkyd-based, Interior wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.9 mils.
      1) S-W: Multipurpose Interior Oil Based Primer B49W8820.
   b. First and Second Coats: Semi-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.

2. Alkyd System on interior wood doors: Two finish coats over shop primed substrate.
   a. Primer: None required. All wood doors shall be shop primed.
   b. First and Second Coats: Semi-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.

C. Interior Hollow Metal Frames:
1. Semigloss Alkyd-Enamel System: Two finish coats over a factory primed substrate.
   a. Primer: None required. All hollow metal doors and frames shall be shop primed.
   b. First and Second Coats: Semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
      1) S-W: Pro Mar 200 Interior Alkyd Semi-Gloss B34-200 Series

D. Interior Steel Substrates:
1. Semigloss, Alkyd Enamel System on interior ferrous metal attic stair door: 2 finish coats over a rust-inhibitive primer.
   a. Primer: Spot prime as recommended by the manufacturer to achieve a total dry film thickness of not less than 3.0 mils.
      1) S-W: Pro-Cryl Universal Water Based Primer
   b. First and Second Coats: Semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
      1) S-W: Pro Mar 200 Interior Alkyd Semi-Gloss B34-200 Series

3.6 EXTERIOR PAINTING SCHEDULE
A. Fiber-Cement Siding:
1. Latex System: Two finish coat over shop primed substrate.
   a. Primer: Not required. Clean and prepare substrate per manufacturer's recommendations.
   b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, exterior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
      1) S-W: Exterior Latex Satin A82-100 Series

B. Exterior CMU Substrates:
1. Latex System: Two finish coat over shop primed substrate.
   a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils.
   b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, exterior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils.
      1) S-W: Exterior Latex Satin A82-100 Series

C. Exterior Hollow Metal doors and Frames:
1. Semigloss Industrial Alkyd or Modified Alkyd Enamel System: Two finish coats over a factory primed substrate.
   a. Primer: None required. All hollow metal doors and frames shall be shop primed.
   b. First and Second Coats: Semigloss, alkyd, exterior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
      1) S-W: Direct-To-Metal Enamel B55 Series.

D. Exterior Steel:

1. Semigloss Alkyd Enamel System over steel bollards: Two finish coats over shop primed substrate.
   a. Primer: None required.
   b. First and Second Coats: Semigloss, acrylic clear coat applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.0 mils.
      1) S-W: Industrial Urethane Alkyd Enamel B54-100 Series

END OF SECTION 09 9000
SECTION 102113- PHENOLIC CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic core compartment partitions for following applications:
   a. Toilet enclosures.
   b. Urinal screens.

1.2 REFERENCES

A. ASTM International (ASTM):

2. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. International Code Council (ICC)/American National Standards Institute (ANSI):

1. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities, as applicable to toilet compartments designated as accessible.

C. United States Department of Justice:


1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated. Include fabrication details, description of materials and finishes.

1. Product Test Reports: When requested by Architect, submit documentation by qualified independent testing agency indicating compliance of products with requirements.

B. Shop Drawings: Include overall product dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.
C. Samples for Selection: Furnish samples of manufacturer's full range of colors for initial selection.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance and cleaning instructions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years experience in the manufacture of toilet compartments.

B. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years experience in the manufacture of toilet compartments. Manufacturers seeking approval must submit the following in accordance with Instructions to Bidders and Division 01 requirements:

1. Product data, including test data from qualified independent testing agency indicating compliance with requirements.
2. Samples of each component of product specified.
3. List of successful installations of similar products available for evaluation by Architect.

C. Installers Qualifications: Experienced Installer regularly engaged in installation of toilet compartments for minimum 3 years.

D. Source Limitations: Obtain toilet compartment components and accessories from single manufacturer.

E. Accessibility Requirements: Comply with requirements of ICC/ANSI 117.1, and with requirements of authorities having jurisdiction.

F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 30.
2. Smoke-Developed Index: 110.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver toilet compartments to site until building is enclosed and HVAC systems are in operation.

1. Deliver toilet compartments in manufacturer's original packaging.
2. Store in an upright condition.
1.8 WARRANTY

A. Special Manufacturer’s Warranty: Provide manufacturer’s standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship during the following period after substantial completion:

1. Phenolic Core Toilet Partitions: Against delamination: 3 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Bradley Corporation, Mills Metals Division, Menomonee Falls, WI 53051 OR equal.

1. Contact Information: (800)272-3539, fax (262)251-5817; Email info@BradleyCorp.com; Website www.bradleycorp.com.

2.2 MATERIALS

A. Phenolic Core: Compressed cellulose impregnated with phenolic resins. Provide smooth material, without creases or ripples.

B. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.

C. Stainless Steel Sheet: ASTM A 240 or A 666, 300 series.

D. Stainless Steel Castings: ASTM A 743/A 743M.

E. Aluminum: ASTM B 221.

2.3 PHENOLIC CORE TOILET COMPARTMENTS

A. Toilet Compartment Type:

1. Overhead braced.
   a. Basis of Design Product: Bradley, Mills Partitions, Sentinel, Series 400 or equal.

B. Urinal Screen Style:

1. Wall hung with wing bracket:
   a. Basis of Design Product: Bradley, Mills Partitions, Model No. 2 or equal.
   b. Provide chrome plated wing bracket for mounting to wall.


1. Provide exposed surfaces free of pitting, visible seams and fabrication marks, stains, telegraphing of core material, or other imperfections.
2. Core Material: Manufacturer's standard solid resin core of thickness required to provide finished thickness for doors, panels and pilasters.

D. Door Construction: 3/4 inch (19 mm) thick.

E. Panel Construction: 1/2 inch (13 mm) thick.

F. Pilaster Construction: 3/4 inch (19 mm) thick.

1. Provide pilaster with mechanically fastened leveling bar reinforcement with zinc-plated jack bolt for leveling.

G. Headrail: Extruded anodized aluminum headrail with anti-grip profile. Provide clamps for attachment to pilaster and stainless steel brackets to secure to wall.

H. Shoes: 4 inches (102 mm) high minimum, Type 304 stainless steel with No. 4 satin brushed finish. Provide concealed retainer clips to attach to pilaster.

I. Urinal-Screen Construction: Matching toilet compartment panel construction

J. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.

K. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; chrome-plated zamak.
2. Full-Height (Continuous) Type: Manufacturer's standard design; aluminum.

L. Phenolic Core Finish: Manufacturer's standard impregnated, with one color in each room.

1. Color: As selected by Architect from manufacturer's full line.

2.4 HARDWARE

A. Hardware, Standard Duty: Manufacturer's standard chrome-plated zamak castings, including corrosion-resistant, tamper-resistant fasteners:

1. Hinges: Self-closing surface mounted, through bolted, with gravity cams, adjustable to hold doors open at any angle up to 90 degrees, with emergency access by lifting door.
2. Latch and Keeper: Surface-mounted slide latch with flat rubber-faced combination door strike and keeper, with provision for emergency access, meeting requirements for accessibility at accessible compartments.
3. Coat Hook: Combination hook and rubber-tipped stop, sized to prevent door from hitting compartment-mounted accessories. Provide wall bumper where door abuts wall. Provide formed L-shaped hook without stop at outswing doors.
4. Door Pull: Standard unit on outside of inswing doors. Provide pulls on both sides of outswing doors.

2.5 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
B. Urinal-Screen Posts: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provide caps, shoes, and covers at posts to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 26-inch- (660-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine work area to verify that measurements, substrates, supports, and environmental conditions are in accordance with manufacturer’s requirements to allow installation.

1. Proceed with installation once conditions meet manufacturer's requirements.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

B. Install toilet partitions and screens in spaces with operating, temperature controlled HVAC systems. Shield partitions and screens from direct sunlight.

C. Clearances: Install with clearances indicated on Drawings. Where clearances are not indicated, allow maximum 1/2 inch (13 mm) between pilasters and panels, and 1 inch (25 mm) between panels and walls.

D. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 15 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

3.4 FINAL CLEANING

A. Remove packaging and construction debris and legally dispose of off-site.

B. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.
END OF SECTION
SECTION 10801 - TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.

B. Owner-Furnished Accessories: Soap Dispensers are owner provided. All other accessories are provided and installed per these documents.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
   1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify products using designations indicated.

D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.


E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).


A. Grab Bar:
   2. Mounting: Concealed mounting flange 1/8" thick stainless steel plate, 2" W x 3-1/8" H, with two screw holes for concealed anchors.
   5. Configuration and Length: straight 36”, 42”, 18”.

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers’ written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer’s written recommendations.

END OF SECTION 10801
SECTION 22 1113 – FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes water-distribution piping and specialties for the following:
   1. Water services.
   2. Combined water service and fire-service mains.

1.2 SUBMITTALS

A. Product Data: For the following:
   1. Valves and accessories.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For the following:
   1. Valves.
   2. Backflow Preventers
   3. Meters
   4. Hydrants

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water (City of Topeka). Including tapping of water mains and backflow prevention.
   2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
      a. Comply with City of Topeka Standard Specifications
   3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. NSF Compliance:
   1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
   2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
1.4 PROJECT CONDITIONS

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 Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer’s written permission.

1.5 COORDINATION

A. Coordinate connection to water main with utility company.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. 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.
4. Manufacturers: Subject to compliance with requirements, provide products by 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 PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Cement Lined (DICL) Pipe: ANSI A 21.51 (AWWA C151 or latest revision), with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.

1. All ductile iron cement lined pipe shall meet the requirements of Pressure Class 350 pipe for sizes 12" and smaller, and pressure class 250 for all pipe 16" and larger, unless otherwise indicated on the plans. The exterior of the pipe shall be coated with a bituminous coating of coal-tar or asphalt base at least one mil thick. The interior of the pipe shall have a cement lining in accordance with ANSI A21.4 (AWWA C104) with a
Bituminous Seal-Coat. Joints shall be slip type with single rubber gasket in accordance with Subsection 803.6.

2. Mechanical-Joint, Ductile-Iron Cement Lined Fittings: ANSI/AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern with interior and exterior coatings as described above for DICL.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and stainless steel bolts.

B. PVC, Schedule 40 Pipe (2 ½” pipe and smaller): ASTM D 1784, Type 1, Grade 1 for PVC Compounds; ASTM 2241 for PVC pipe; commercial standard CS-256 for PVC pipe; and NSF Standard number 14.
   1. Class 200, suitable for working pressure of 200 psi at 73 degrees F.
   2. Push-on Joints with rubber ringed couplings conforming to ASTM D-1869.

C. PVC, AWWA Pipe (4” and larger): AWWA C900 or C-905 depending on pipe diameter.
   1. DR-18 with Cast Iron outside diameter.
   2. Push-on Couplings with rubber rings consisting of vulcanized rubber compounds, free from porosity; or bell ends manufactured integral to the pipe.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Soldering Flux: ASTM B 813, water-flushable type.

C. Solder Filler Metal: ASTM B 32, lead-free type with 0.20 percent maximum lead content.

D. Butt Fusion (HDPE PIPE): Per Manufacturer’s recommendations.

2.5 VALVES

A. AWWA, Cast-Iron, Gate Valves (smaller than 12”):
   1. Double Disc gate or resilient seat wedge type gate with non-rising stem conforming to AWWA C500-80 and C509-80 or the latest revision.
   2. Open left
   3. All Bronze disc assemblies and internal parts.
   4. Resilient seat wedge-type gate valves shall have a replaceable internally reinforced specially contoured molded rubber disc seat ring attached to the face of the disc with self-locking stainless steel screws or shall consist of a gate with a bonded elastomer seat which in the closed position is fully encapsulated and effects a bubble tight seal across the disc at a full differential of 200 psi. Stem and stem nut shall be bronze material.
   5. 2-inch square operating nut, “o” ring seals,
   6. Minimum Working Pressure: 175 psi
   7. Test Pressure: 300 psi
   8. End Connections: Mechanical joint with Corten material mechanical joint bolts and nuts or approved equal.
   10. Exterior Coating: epoxy coated, 8 mils thick.
2.6  GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.
   1. All tapping of water mains shall be completed by the City of Topeka Water Utility Division at the contractor's expense.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch- diameter barrel.
   1. Operating Wrenches: Steel tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.7  FIRE HYDRANTS

A. Approved Fire Hydrants: All Hydrants must be as specified by Topeka Standard Specifications.
   1. American Darling Mark 73
   2. Clow Medallion
   3. Kennedy K81A
   4. M & H 929
   5. Mueller 107
   6. Mueller Super Centurion 200
   7. U.S. Pipe Metropolitan 5 ¼"

2.8  CORPORATION VALVES AND CURB VALVES

A. Manufacturers:
   1. Grinnell Corporation; Mueller Co.; Water Products Div.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
   1. All tapping of water mains shall be completed by the Contractor; however, a representative of the City of Topeka must be on-site to observe tapping operations.

C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over curb valve, and approximately 3-inch- diameter barrel.
   1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.9  REINFORCED CONCRETE VALVE VAULTS

A. All reinforced concrete valve vaults shall be constructed in accordance with the City of Topeka Standard Specifications.
PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

B. Underground Water-Service Piping: Use either of the following piping materials for each size range:
   1. NPS 3/4 to NPS 3: PVC, Schedule 40 pipe; PVC, Schedule 40 Push-on joint with rubber ringed couplings.
   2. NPS 4: PVC, AWWA C 900 pipe; DR-18; AWWA Class 150 molded fittings; and gasketed joints.

C. Underground Fire-Service-Main (12" and smaller): Ductile-iron Cement Lined (DICL) Pressure Class 350, AWWA C151, mechanical joint fittings, AWWA C110.
   1. DICL Joint ends per AWWA C111.

3.2 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

3.3 JOINT CONSTRUCTION

A. Make pipe joints according to the following:
   3. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
   4. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 2 Section "Utility Materials" for joining piping of dissimilar metals.

3.4 PIPING INSTALLATION

A. All water line installation shall be in accordance with the City of Topeka Standard Specifications. The City Standard Specifications shall be utilized should there be any discrepancies between these specifications, the plans and the City Standard Specifications.
B. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41. All Ductile iron pipe and fittings shall be wrapped in an 8-mil polyethylene wrap. The wrap shall be continuous, securely taped and provide a continuous barrier between the pipe and bedding/backfill. Installation of wrap per manufacturer’s recommendations.

D. Install PVC, AWWA pipe according to AWWA M23 and ASTM F 645.

E. Bury 8” and smaller piping with depth of cover over top at least 42 inches, with top at least 12 inches below level of maximum frost penetration.

F. Bury 12” to 16” piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration.

G. Extend water-service piping and connect to water-supply source and building water piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600, C603 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

1. Valve boxes to be installed vertical and plumb.

B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

C. Concrete supports shall be provided under valves in vaults. The support shall be constructed one inch (1”) low and the void between the support and valve filled with non-shrink grout. Buried valves shall be supported on poured concrete blocks.
3.7 SEPARATION OF WATER MAINS AND SEWERS

A. When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10' (ten feet). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10' (ten foot) separation, the Engineer will consider proposals providing equivalent protection by other methods on a case-by-case basis.

1. When a water pipe and a sanitary sewer cross and the sewer is 2' (two feet) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one (1) of the following materials and the water pipe shall be pressure tested to assure water tightness pursuant to the section on exfiltration tests.

2. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness Class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.

3. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR35 or ASTM F679 with gasketed push-on joints in conformance with ASTM D3212.

4. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

B. Joints in the sewer pipe shall be located as far as practical from the intersected water main with a 20' length of pipe centered on the waterline.

C. Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2' (two feet) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of 6" (six inches) thickness for a 10' (ten foot) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements.

D. The same horizontal separation requirements as listed above shall apply in the same manner to water service pipes and building sewers.

E. There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs or distribution systems.

3.8 REINFORCED CONCRETE VALVE VAULTS

A. All reinforced concrete valve vaults shall be installed per City of Topeka Standard Specifications.

3.9 CONNECTIONS

A. Piping installation requirements per the City of Topeka Standard Specifications. Drawings indicate general arrangement of piping and specialties.

B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.
3.10 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
   1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.11 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 32 Section "Earth Moving" for underground warning tapes.

B. Location Wire: Contractor shall furnish and install #12 THNN copper location wire. Wire to lay adjacent to and below the centerline of all new mains and service lines. Wire to extend up in all valve boxes, meter boxes. Wire in valve box to be located in 1/2" PVC.

3.12 CLEANING

A. Clean and disinfect water-distribution piping as follows:
   1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
   3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
      a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
      b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
      c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 22 1113
SECTION 22 1313 – FACILITY SANITARY SEWERS

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 sanitary sewerage outside the building.

1.3 DEFINITIONS
   A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS
   A. Gravity-Flow, Non-pressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS
   A. Product Data: For the following:
      1. Sewer cleanouts.
      2. Manhole cover inserts.
   B. The Contractor shall furnish certification that all sanitary sewer materials comply with the requirements of these Specifications.
   C. Shop Drawings: Include plans, elevations, details, and attachments for the following:
      1. Precast concrete manholes, including frames and covers.
      2. Cast-in-place concrete manholes and other structures, including frames and covers.
   D. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
   E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Do not store plastic structures, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. 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 Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Where the Plans call for sanitary sewer pipe, the Contractor may use either ductile iron pipe or polyvinyl chloride pipe but must not interchange types of pipe unless otherwise noted on the plans or approved by the Engineer. When the Plans call out a certain type and/or class of pipe, this pipe will not be substituted.

2.2 PIPES AND FITTINGS

A. Ductile-Iron Sewer Pipe: Ductile iron pipe shall meet the requirements of AWWA C151/ANSI A21.51 and AWWA C150/ANSI 21.50. Minimum wall thickness shall be Class 52 unless otherwise specified on the plans for pipe greater than 6” and Class 52 on 4” pipe.

   1. Mechanical joints for ductile-iron pipe shall be gasketed and bolted joints meeting the requirements of the latest revision of ANSI A21.10 (AWWA C110).
   2. Except when mechanical joints are specified in the Plans, ductile-iron pressure pipe may be joined with a single rubber gasket push-on joint. Push-on joints used shall meet the requirements of the latest revision of ANSI A21.10 (AWWA C110), "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings".
   3. Fittings: All fittings used with ductile-iron pipe shall be cast-iron or ductile-iron fittings meeting the requirements of the latest revision of ANSI S21.10 (AWWA C110), "Gray-Iron and Ductile-Iron Fittings, 3 Inch through 48 Inch, for Water and Other Liquids."
   4. Protective Coatings: The exterior of all underground ductile iron pipe and fittings shall have a bituminous coating according to AWWA C151/A21.51 and be 1-mil in thickness.
   5. All buried ductile iron pipe and fittings shall be encased in seamless, 8 mil, polyethylene (PE) tube conforming to ANSI/AWWA C105/A21.5. Encasement shall be installed in accordance with the following installation:

      a. Method A: Ends of tubing shall be overlapped at least 12” and shall be thoroughly sealed with PE adhesive tape.
b. Repairs: All cuts, tear, punctures, or other damage to the PE shall be repaired using adhesive tape or with a short length of PE sheet or tube cut open, wrapped around the pipe to cover the damaged area and secured in place.

6. Protective Lining: The inside of the pipe (8" and larger) shall be lined with a chemically inert liner such as “Polylined” as manufactured by United States Pipe & Foundry Company or approved equal. Liner shall have a nominal thickness of 40 mils and a minimum thickness of 20 mils.

B. Polyvinyl Chloride (PVC) Pressure Pipe and Fittings: ASTM D 1785, Schedule 40 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 40, socket-type fittings.

C. Polyvinyl Chloride (PVC) Plastic Pipe:

1. Gravity Sewer Lines: Polyvinyl Chloride (PVC) solid wall pipe and fittings with integral bell elastomeric seal joints, shall conform to the requirements of ASTM Designation: D-3034 for nominal sizes of 8 inch through 15 inch and ASTM Designation F679-PS46 for nominal sizes of 18 inch through 27 inch, with a standard dimension ratio (SDR) of 35 or better for all gravity sewers. Pipe and fittings shall be manufactured from Type I, Grade I, Polyvinyl Chloride (PVC) compound and materials conform to the requirements of ASTM Designation: D 1784, Class 12454-B. The materials shall have a tensile strength and tensile modulus tested in accordance with ASTM Designation: D 638.

2. PVC pipe fittings shall have the same pressure rating as the pipe and shall be marked on the body or hub on both sides. The markings shall include the manufacturer's name or trademark, nominal size, grade rating and symbol PVC type designation: i.e. PVC Type 1.

3. Joints: The pipe shall be joined with a bell-and-spigot type of rubber gasketed joint. Each joint shall consist of a formed bell complied with a single rubber gasket. All fittings shall utilize rubber gasketed joints. The gaskets shall meet the requirements of ASTM Designation: F 477 with configuration conforming to the requirements of ASTM Designation: D 3212.

4. Gasket Joint Pipe (PVC): The following requirements shall be applicable to all varieties of Polyvinyl Chloride (PVC) plastic pipe provided under this Contract.

   a. Gasket joint pipe shall meet all of the manufacturing requirements specified herein. The pipe shall be coupled and sealed against infiltration and exfiltration by means of rubber rings seated in the integral bell. Pipe that has an integral bell as a part of the pipe with a single gasket will be approved. All integral bells shall having a seating depth recommended by the manufacturer and acceptable to the Engineer. The male ends of the pipe shall be fabricated for ease of entry into the coupling.

   b. The manufacturer shall deliver the pipe to the job site by means which will adequately support it and not subject it to undue stress. The load shall be so supported that the bottom rows of pipe are not damaged by crushing. The pipe shall be carefully unloaded and stored on the project at a site prepared and furnished by the Contractor.

   c. All gasketed joints shall be lubricated as recommended by the pipe manufacturer and as approved by the Engineer.

D. Service Lines: Four (4) inch and Six (6) inch PVC pipe and fittings shall conform to the requirements of ASTM D1785 & ASTM D2665 Schedule 40.

   1. Materials used in manufacturing of the pipe shall conform to the compound requirements of ASTM Designation: D 1784, Cell Class 12454 B.

   2. A prefabricated adapter shall be used between the SDR branch fitting and the Schedule 40 service line. The adapter shall be an IPS hub by sewer spigot model manufactured by
GPK or approved equal. A concrete cradle under the wye will not be required for PVC Pipe unless shown on the plans or directly by the Engineer.

2.3 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 8-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: concentric-cone type, unless eccentric-cone type or flat-slab-top type is indicated or use eccentric-cone if manhole is greater than 4' in diameter. Top of cone of size that matches grade rings.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
7. Steps: No Steps within Sanitary Sewer Manholes

B. Manhole Frames and Covers: ASTM A 48, Class 35B or higher, except as modified or supplemented herein, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "SANITARY SEWER" cast into cover. All frames shall be bolted to the concrete manhole wall. All covers shall be bolted to the manhole frame.

1. Manhole frames and covers shall be manufactured so as to be fully interchangeable. All of the covers provided shall be suitable for installation on any of the frames provided and shall not rock or tip under an applied load.
2. All castings imported into the United States shall conform to the applicable provisions of the United States Customs regulations.
3. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
4. (4) Rings and bolt-down covers shall be proved with machined surfaces, O-ring gaskets and five-eighths (5/8) inch pent-head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

C. Resilient Connectors between reinforced concrete manhole structures and pipes shall conform to the requirements of ASTM C 923 and shall be of two types:

1. Type cast into manhole wall at the manufacturing facility. The connection is completed by inserting end of pipe through connector. Connector shall be A-Lok or approved equal.
2. Type clamped around end of pipe and grouted into opening in manhole wall. This type is suitable for connecting to an existing structure. Connector shall be Fernco Concrete Manhole Adaptor or approved equal. Non-shrink grout must be used.
3. The purpose of the resilient connector shall be to achieve a positive watertight connection between pipe and structure. The connectors cast into manhole walls may be used as
flexible connections between pipe and manhole. The connectors clamped to pipes and grouted into manhole walls must be used as rigid connections.

2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to one-half of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. Invert Slope: 2 percent through manhole (minimum) or as indicated on plans

2. Benches: Concrete, sloped to drain into channel.
   a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.5 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Place top in 2'x2' Concrete pad and slope to drain away (2.00% min.) on 3" washed gravel.
2. Provide housing in paved areas.
   a. Deeter foundry #1815 or approved equal.

B. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top Loading Classification: Heavy duty.
2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service Class, Cast-Iron soil pipe and fittings.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section “Earth Moving”.

3.2 CONSTRUCTION REQUIREMENTS

A. Handling Pipe and Pipe Fittings: All pipe, fittings and specials shall be delivered, unloaded, stockpiled, hauled, distributed, installed, and otherwise handled in a manner which will prevent breakage or other damage thereto and which will insure the delivery and installation thereof in a sound and acceptable condition.
   1. PVC pipe and fittings shall be protected from direct sunlight. It shall be stored in a horizontal position supported along its entire length and shall not be stacked more than two feet in height.
   2. Rubber gaskets shall be stored in the original containers in a cool, dark place. Rubber gaskets shall be kept away from oil and grease, sunlight, heat and ozone producing equipment.

B. Cutting of Ductile-Iron Pipe: Cutting of ductile-iron pipe shall be done in a neat and workmanlike manner without damage to the pipe. Cutting shall be done by means of an approved type of mechanical cutter. Wheel cutters shall be used when practicable.

C. Cutting of PVC Pipe: Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise authorized by the Engineer, cutting shall be done by means of an approved type of power saw with a fine tooth blade. Pipe shall be cut square, the burrs removed inside and outside, and the outside beveled with knife and coarse file.

D. Location and Grade of Sewers: Sewers and structures appurtenant thereto shall be located as shown by the Plans and as staked or otherwise fixed by the Engineer. The grade and alignment of each gravity sewer shall be determined by use of a laser beam device. The line and grade of the sewer line shall be checked periodically to insure proper alignment.

   1. Sewer Pipe Installation: Pipe laying shall commence at the lower end of the section and proceed upgrade. Pipe shall be laid so that the spigot or tongue end points in the direction of flow and the bell end facing upstream and bell holes excavated as required.
   2. All sewer pipe shall be installed to exact line and grade and special care shall be taken to avoid disturbing line and grade of pipe already jointed and laid. All pipe shall be graded and bedded as provided in the general excavation and trenching specifications. When pipe is installed and jointed in trench, it shall form a true and smooth line of sewer, and pipes shall not be trimmed or cut except for closures. Any pipe not making a good fit shall be removed. Pipe shall be kept in a clean condition before being installed in the trench and when installed shall have all interior surfaces of the pipe sockets and exterior surfaces of pipe joints clean and dry before any jointing is performed. When necessary in the opinion of the Engineer, a suitable swab or drag shall be pulled through each joint of pipe as it is laid and jointed.
   3. All sewers constructed under this Contract must be kept thoroughly clean. When the trench is left at night or the pipe laying stopped, the upper end of the pipe must be closed.
by using a watertight sewer cap or plug in the socket end of the last pipe. The downstream end of the pipe shall be plugged in a positive manner until satisfactory to the Engineer until construction, cleaning, and testing are complete.

3.3 INSTALLATION OF PIPE:

A. Installation of Ductile-Iron Pipe: While suspended in the sling and before lowering into the trench or onto the supports, the pipe shall be inspected for defects and tapped with a light hammer to detect cracks. Defective, damaged, or unsound pipe will be rejected. The pipe shall be carefully bedded with bell holes excavated to insure that each pipe shall rest firmly upon its bed for its full length, and shall be laid true to the lines and grades shown on the Plans. Except where necessary in making connections with other lines, or as authorized by the Engineer, pipe shall be laid with the bells facing the direction of laying-upstream.

1. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
2. Install ductile-iron special fittings according to AWWA C600.

B. Installation of PVC Force Main Pipe:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with 36-inch minimum cover.
3. Install PVC pressure piping according AWWA M23 or ASTM D 2774 and ASTM F 1668.

C. Installation of PVC Gravity Pipe: Polyvinyl chloride (PVC) pipe for gravity sewer lines shall be installed in accordance with the recommended practice of ASTM Designation: D2321. The installation of solvent weld joint pipe and fittings shall be made in accordance with ASTM F402.

1. PVC pipe and fittings shall be inspected for defects or damages prior to lowering into the trench. Any defective, damaged, or unsound pipe shall be repaired or replaced and all foreign matter and soil should be removed from the interior of the pipe and fittings before lowering into the trench.
2. The pipe shall be carefully bedded with bell holes excavated to insure that each pipe shall rest firmly upon its bed for its full length, and shall be laid true to the lines and grades shown on the Plans. Except where necessary in making connections with other lines, or as authorized by the Engineer pipe shall be laid with the bells facing the direction of laying-upstream.

D. Concrete Embedment and Encasement of Sewer Pipe: Concrete embedment or encasement of sewer pipe shall be installed where and as shown by the Plans or as provided by any other Contract Document; also where, in the opinion of the Engineer, such pipe reinforcement is necessary because of any unforeseen condition encountered in the work.

1. Concrete used in pipe embedment or encasement shall be furnished, placed and compacted in conformity with the section on concrete. Reinforcement steel shall be provided where and as required.
2. Concrete embedment or encasement of sewer pipe shall be preceded by the following preliminary steps:
   a. Unless a slab is cast separately, each length of pipe shall be installed on a brick or concrete block or other support approved by the Engineer and located close to the...
pipe bell and spaces not to exceed 5’. The pipe shall be brought to exact line and grade by means of wedges placed on each side of the pipe.

b. Each length of pipe shall be rigidly held in lateral and vertical alignment by means approved by the Engineer and at least 3 locations along each length of pipe. This includes anchoring to prevent the pipe from vertical movement due to flotation.

c. Pipe joints shall be filled or otherwise sealed with the same materials and in the same manner as other joints in the same line of sewer.

d. All loose material shall be removed from the trench prior to placing any concrete therein. The concrete as installed shall have a continuous and uniform contact with undisturbed trench excavation material on both sides and the bottom of the trench except (1) where side forms are indicated or permitted by the Plans or (2) where sheeting is left in place in the trench, in which case the concrete is to be poured directly against the sheeting.

E. Installation of Pipe Joints:

1. Ductile-Iron Pipe: Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Table 5 or Table 6 of AWWA C600 for ductile-iron pipe. Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.

   a. Mechanical Joints: Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over-tightening bolts to compensate for poor installation practice will not be permitted.

   b. Push-on Joints: All instructions and recommendations of the pipe manufacturer relative to gasket installation and other jointing operations, shall be followed by the Contractor. All joint surfaces shall be lubricated with a lubricant recommended by the manufacturer and approved by the Engineer immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in close containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

2. Polyvinyl Chloride (PVC) Pipe: All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations, shall be followed by the Contractor. Lubricants shall be applied in accordance and of the type recommended by the pipe manufacturer. Each pipe end and coupling shall have tapered edges to facilitate assembly.

   a. Join PVC pressure piping according to ASTM F 402 for solvent weld joint pipe and fittings.


F. Sewer Lines to be Kept Clean: All sewer lines must be kept thoroughly clean. Where a connection has been made to an existing manhole, the downstream end of the newly constructed sewer line shall be sealed so that no water or dirt can enter the existing pipe or system. During construction, the water level in any part of the newly constructed sewer system shall not be permitted to exceed 3.5 feet in depth. Upon completion of the new construction work, all sewer lines shall be thoroughly cleaned, dewatered, and accepted by the Owner before a permanent connection is made by removing the seal.

G. Tees and Wye Branches: Tees and wye branches shall be located at the points shown on the Plans or designated by the Engineer. The branch connection shall be set at no greater than 45°
(forty-five degrees) to the horizontal and so that the lower lip of the branch is not more than two (2) inches below the outside top of the pipe. All wye branches shall be cocked to a 45° (forty-five degree) angle to the plane of the sewer line. A riser pipe for sewer service connections shall be installed to the branch where noted on the Plans. After installation, branches or riser pipes shall not be covered with backfill until determination and record has been made by the Engineer of the location of each with reference to the nearest manhole downstream therefrom, and the direction in which the branch faces.

1. When sewer is to be backfilled before the service line connection is made to building, each branch or riser pipe shall be marked with a wooden 2” x 4” extending from the branch or the top of the riser pipe vertically to within 1’ (one foot) of the ground surface or as noted on the Plans. All such markers shall be securely anchored and maintained in a proper vertical position until backfilling has been completed. Branch locations shall also be marked for visual location after backfilling, with an orange 6’ (six foot) steel T-post. The post shall be set along the property line, right-of-way, easement line or as noted on the Plans. Branches or riser pipes shall be closed by means of suitable stoppers, or fitted with factory-molded joints. Stoppers shall be further sealed after installation with mastic joint filler. All work and materials used to mark the location of the service connections or wye shall be subsidiary to other bid items.

2. Service Connections: Service connections made to the sewer prior to backfill shall not be installed in the pipe trench as vertical risers. The following sections describe two (2) methods of installing riser pipes. Each service line shall be marked with a wooden 2” x 4” extending from the line vertically to within 1’ (one foot) of the ground surface or as noted on the Plans. The end of the service line shall also be marked for visual location after backfilling with an orange 6’ (six foot) steel T-post placed at the property line, right-of-way or easement line or as noted on the Plans.

a. Method A: Where conditions permit, the branch connection shall be placed at no greater than 45° (forty-five degrees) to the horizontal and the riser pipe shall be laid on the slope not to exceed 1’ (one foot) vertical to 1’ (one foot) horizontal cut back into the trench bank in such a manner that the service connection pipe will have a solid bearing of undisturbed earth for bedding material to be placed. The riser pipe shall be laid to the property line or easement line on this method.

b. Method B: In locations where the sewer trench is too deep for the riser pipe to be extended within 6’ (six feet) of the surface using Method A and the trench walls are vertical, firm, undisturbed materials, the branch connection shall be set 45° (forty-five degrees) to the horizontal and a 45° (forty-five degrees) bend shall be placed on the branch. The branch and band shall be encased in concrete. A short piece of pipe may be required between the branch in the bend so that the riser pipe can be placed in the 45° (forty-five degrees) bend and extended up the side of the trench wall with the riser length called out on the plans. The wall of the ditch shall be recessed to contain approximately half of the riser pipe. The pipe shall be securely pinned in place by driving a minimum of two (2) stakes into the bank to prevent moving while backfilling.

H. Separation of Water Mains and Sewers: When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10’ (ten feet). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10’ (ten foot) separation, the Engineer will consider proposals providing equivalent protection by other methods on a case-by-case basis.

1. When a water pipe and a sanitary sewer cross and the sewer is 2’ (two feet) or more (clear space) below the water pipe, no special requirements or limitations are provided
herein. At all other crossings, the sanitary sewer is to be constructed of one (1) of the following materials and the water pipe shall be pressure tested to assure water tightness pursuant to the section on exfiltration tests.

2. Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness Class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.

3. PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR35 or ASTM F679 with gasketed push-on joints in conformance with ASTM D3212.

4. Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

5. Joints in the sewer pipe shall be located as far as practical from the intersected water main with a 20' length of pipe centered on the waterline.

6. Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2' (two feet) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of 6" (six inches) thickness for a 10' (ten foot) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements.

7. The same horizontal separation requirements as listed above shall apply in the same manner to water service pipes and building sewers.

8. There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs or distribution systems.

I. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

J. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

K. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

L. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

M. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.

2. Install piping with 36-inch minimum cover.

N. Extend sanitary sewerage piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

O. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
3.4 MANHOLE INSTALLATION
   A. General: Install manholes, complete with appurtenances and accessories indicated.
   B. Form continuous concrete channels and benches between inlets and outlet.
   C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements.
      Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.
   D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
   E. Construct cast-in-place manholes as indicated.

3.5 CONCRETE PLACEMENT
   A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.6 CLEANOUT INSTALLATION
   A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Install piping so
      cleanouts open in direction of flow in sewer pipe.
   B. Set cleanout frames and covers in earth in cast-in-place concrete block, 24 by 24 by 7.25 inches
      deep. Set with tops 1 inch (25 mm) above surrounding grade.
   C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.7 TAP CONNECTIONS
   A. Make connections to existing piping and underground structures so finished Work complies as
      nearly as practical with requirements specified for new Work.
   B. Use commercially manufactured saddle fittings for piping branch connections. Make branch
      connections from side into existing piping. Remove section of existing pipe; install saddle fitting
      into existing piping; and encase entire saddle with not less than 6 inches (150 mm) of concrete
      with 28-day compressive strength of 3000 psi (20.7 MPa).
      1. Use epoxy-bonding compound as interface between new and existing concrete and
         piping materials.
   C. Protect existing piping and structures to prevent concrete or debris from entering while making
      tap connections. Remove debris or other extraneous material that may accumulate.

3.8 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS
   A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in
      place. Include closures strong enough to withstand hydrostatic and earth pressures that may
      result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8-inch- (200-mm-) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Structures: Excavate around structure as required and use one procedure below:

1. Remove structure and close open ends of remaining piping.
2. Backfill to grade according to Division 2 Section "Earthwork."

3.9 FIELD QUALITY CONTROL

A. ACCEPTANCE TESTS: All sewer lines shall undergo and pass tests to determine the soundness and workmanship regarding alignment grade, infiltration, exfiltration and/or pressure. Sewer lines which do not conform to the requirements shall be repaired and/or replaced along with all appurtenant work necessary to complete the entire work at no additional cost to the Owner and shall be retested until the sewer line is of a condition meeting the requirements. Results of each test shall be recorded by the Contractor and not less than three (3) copies of the test transcripts shall be submitted to the Engineer. The transcripts shall include sufficient information to readily identify the type of test, location tested, dated, person(s) performing the test, and the test results.

1. Visual Internal Inspection: The visual inspection of each reach of completed sewer line shall be made between manholes of gravity systems, by use of mirrors deflecting sunlight into the sewer line, or lighting systems, or when possible, a physical inspection by crawling through the sewer line. Visual inspection shall be made only after all backfill has been properly placed. The inspection is to ensure that the sewer line is clean and free of obstructions, dirt or other matter not intended to be within the system and that it has been installed to uniform grade and proper alignment. Poor alignment, non-uniform grade, infiltration, displaced joints, obstructions and/or other defects shall be corrected and/or repaired at no additional cost to the Owner, and the line then reinspected.

2. Infiltration Testing: Infiltration tests shall be performed whenever gravity sewer lines are below the groundwater table. Infiltration of ground water into newly constructed gravity sewer lines shall not exceed the rate of 200 gallons per inch of nominal pipe diameter per mile of sewer per 24-hour day. Where evidence of infiltration is discovered by the Engineer, the Contractor shall install weirs or other suitable flow rate measuring devices to determine the infiltration flow rate. The Contractor shall install flow rate measuring devices adequate to determine to the satisfaction of the Engineer that the specified infiltration limit is not exceeded for the reach of gravity sewer where evidence of infiltration is discovered. A reach is between any two (2) consecutive manholes. Where the specified infiltration limit is exceeded, the Contractor shall repair or replace the defective reach of sewer line at no additional cost to the Owner. Following repair of defective reaches of sewer line, the Contractor shall remeasure infiltration flow rates and make additional repairs until an acceptable infiltration flow rate is achieved.

3. Exfiltration Tests: An exfiltration test shall be conducted on all sewer lines above the groundwater table by the Contractor using either of the methods as set forth below except when the SUPPLEMENTARY CONDITIONS establishes a specific method to be used.

a. Hydrostatic Test for Gravity Systems: The exfiltration test shall be conducted on each reach of sewer line between manholes with the manholes to be tested separately.
1) Exfiltration tests shall be conducted by blocking off all manhole openings, except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Test sections shall be filled not less than twelve (12) hours prior to testing with sufficient water so that the liquid depth is a minimum of 4' (four feet) above the invert of the sewer at the upstream manhole. The test section shall be refilled prior to performing the test. The depth shall be accurately marked and the time noted. After 24 (twenty-four) hours, the depth shall again be measured and the total exfiltration calculated. The Engineer shall then determine whether the exfiltration is within the limit specified.

2) The total exfiltration shall not exceed 200 (two hundred) gallons per inch of nominal diameter per mile of pipe per 24-hour day for each reach tested. For purposes of determining maximum allowable leakage, manholes shall be considered pipe of equivalent diameter. The sewer line shall be dewatered after the test is completed.

3) The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment and materials required for the tests. The methods used for conducting exfiltration tests shall be acceptable to the Engineer.

b. Low Pressure Air Testing for Ductile Iron Gravity Systems: Air testing may be used in lieu of exfiltration testing. Air testing shall comply with ASTM Designation: C828. Procedures for air testing shall be submitted to the Engineer for review before testing is started.

1) Sewer lines shall be flushed and cleaned prior to testing, thus serving to wet the pipe surface as well as clear out any debris. All openings and outlets shall be plugged in a manner as to resist the test pressure. Special attention should be given to stoppers placed in laterals.

2) Minimum test times for a 1.0-psi pressure drop from 3.5 to 2.5 psi, for various pipe sizes has been established using the formulas contained in ASTM Standard C828 and set forth in the following table.

<table>
<thead>
<tr>
<th>Nominal Pipe Size, in.</th>
<th>Time min./100 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>6</td>
<td>0.7</td>
</tr>
<tr>
<td>8</td>
<td>1.2</td>
</tr>
<tr>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>1.8</td>
</tr>
<tr>
<td>15</td>
<td>2.1</td>
</tr>
<tr>
<td>18</td>
<td>2.4</td>
</tr>
<tr>
<td>21</td>
<td>3.0</td>
</tr>
<tr>
<td>24</td>
<td>3.6</td>
</tr>
</tbody>
</table>

3) If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

4) Air shall be added to the pipeline until the internal air pressure of the sewer line is raised to approximately 4.0 psi gauge. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to...
stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

5) When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gauge, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psi. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gauge during the test period, the line is presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred. If the pipe to be tested is submerged in ground water, determine the backpressure due to ground water submergence and increase all gauge pressures in the test by this amount.

c. Low Pressure Air Testing of PVC Gravity Systems: Low pressure air testing used for testing of PVC lines shall be in accordance with ASTM Designation F-1417/Uni-Bell Designation UNI-B-6-90.

1) Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater influence but not greater than 9.0 psig. After a constant 4.0 psig is reached, the air shall be throttled to maintain that internal pressure for at least two (2) minutes allowing the air temperatures to stabilize. The pressure shall then be decreased to no less than 3.5 psig and timing of the test shall commence.

2) Required test times shall be as indicated in the following tables. Pipe sizes 4 through 12 inch shall be limited to 1.0 psig drop as indicated in Table I and 15 inch and larger shall be limited to 0.5 psig drop in pressure as indicated in Table II.

4. Deflection Test: All polyvinyl chloride (PVC) gravity sewer lines shall be tested by pulling a mandrel through the entire length of sewer pipe. The test shall be conducted not less than one (1) month after backfill has been properly installed. The maximum allowable deflection shall not exceed 5% (five percent) of the pipe's internal diameter.

a. Any section of pipe found not conforming to these requirements shall be replaced by the Contractor at no additional cost to the Owner, and shall then be retested.

b. The Owner may, prior to the end of the warranty period, conduct another deflection test with City personnel. Any pipeline found not conforming to these requirements shall be replaced by the Contractor at no additional cost to the Owner, and the Contractor shall provide an additional warranty for not less than one (1) year for that portion of pipeline so replaced.

5. Force Main Testing:

a. After the force main has been installed, anchored or blocked as specified, the pipe shall be filled with water and subjected to pressure and leakage tests.

b. All piping shall be tested by water pressure at not less than twice the maximum operating pressure or 100 psi, whichever is greater, for a sufficient period to examine the pipeline for leakage, cracks, defects, or other faults. Any leaks shall be repaired and tests repeated until all defects have been repaired.

c. After approval of repairs the pressure shall be set at twice the maximum operating pressure or 100 psi, whichever is greater, and maintained for a period of 3 hours with the total loss of water being measured. The amount of water allowed to be lost during this time shall comply with AWWA C 600 for ductile iron pipe and AWWA Manual M23 for PVC pipe.
d. The test pressure shall be applied by a hand operated force pump, or other suitable device, with the pump taking suction from a reservoir of small enough volume so that the amount of water loss can be measured volumetrically.

e. The contractor shall furnish all water necessary for filling the lines and making the tests.

f. Any leaks which appear within one year after the date of substantial completion shall be repaired at the expense of the Contractor.

B. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
6. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 22 1313
SECTION 31 1000 - SITE CLEARING

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. Protecting existing trees and vegetation to remain.
   2. Removing trees and other vegetation.
   3. Clearing and grubbing.
   4. Topsoil stripping.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

A. Except for topsoil and other materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS (No Requirements)

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract.

C. Notify utility locator service for area where Project is located before site clearing.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.
B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
C. Locate and clearly flag trees and vegetation to remain or to be relocated.
D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
   2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
B. Do not excavate within drip line of trees, unless otherwise indicated.
C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within drip line of remaining trees.

B. Fill depressions caused by clearing and grubbing operations with approved soil material, unless further excavation or earthwork is indicated. (As specified in Section 31 2000 – Earth Moving)
   1. Place fill material and compact as specified in Section 31 2000 – Earth Moving.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water.
   1. Do not stockpile topsoil within drip line of remaining trees.
   2. Stockpile surplus topsoil and allow for re-spreading deeper topsoil.
3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 1000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

Kansas Department of Transportation (KDOT) “Standard Specifications for State Road and Bridge Construction”, latest edition.

“Geotechnical Engineering Report, SW 34th Street and SW Fairlawn Road by CFS Engineers.

1. The complete Geotechnical Report is available from the office of the architect.


1.3 SUMMARY

A. THIS SECTION INCLUDES THE FOLLOWING:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.

2. Drainage course for slabs-on-grade.


4. Subsurface drainage backfill for walls and trenches.

5. Excavating and backfilling trenches for utility trenches.

6. Preparing subgrades for slabs-on-grade.

7. Related Sections include the following:
1.4 DEFINITIONS

Backfill: Job excavated material free from debris, organic material, and large stones.

Initial Backfill: Backfill placed on top of the haunching material in the trench from the spring line to 12" above the top of pipe.

Final Backfill or trench backfill: Backfill placed over initial backfill/embedment to fill a trench.

Base Course: Aggregate layer placed between the subgrade course and hot-mix asphalt paving or between the subgrade course and concrete pavement.

Bedding Course: Material placed over the excavated subgrade in a trench before laying pipe.

Borrow: Satisfactory soil imported from off-site location for use as fill or backfill.

Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

Embedment: Backfill placed around the pipe in the trench consisting of the bedding, haunching, and the initial backfill.

Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Architect. Authorized additional excavation and replacement material will be paid for according to contract provisions for changes in the Work.

Fill: Soil materials used to raise existing grades.

Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

Foundation: Subgrade below bedding material. Typically undisturbed earth unless soil is unsuitable, soft, or mucky.

Haunching: Material placed on top of the bedding material in the trench from the flow line of the pipe to the spring line of the pipe including material to support the sides of pipe.

Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

Subgrade (aka: Final Subgrade or Rough Grade): Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated.

Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Each type of plastic warning tape.
   2. Geotextiles.
   3. Controlled low-strength material, including design mixture.

B. Qualification Data: For qualified testing agency

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Classification according to ASTM D 2487 of each on-site or off-site borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve (Standard Proctor) according to ASTM D 698 (AASHTO T99) for each on-site or off-site borrow soil material proposed for fill and backfill.

D. Submit all purchased items that will be left on site and become the owner’s property after construction.
   1. Gradation for Granular bedding material.
   2. Warning tape

1.6 QUALITY ASSURANCE

Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1. Geotechnical Testing Agency will be retained and paid for by the Contractor.
1.7 PROJECT CONDITIONS

Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

Satisfactory Soils: As approved by the Geotechnical Engineer and free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen materials, vegetation, and other deleterious matter.

Unsatisfactory Soils: As identified by the Geotechnical Engineer or not meeting satisfactory soil conditions.

1. Unsatisfactory soils also include satisfactory soils not maintained within the specified moisture content at time of compaction.

Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

Base Course: KDOT Specifications for AB-3.

2. Engineered Fill: Existing or substituted soils that have been modified for moisture content, compaction liquid limit, plasticity index or plastic limit. Engineered Fill to include low volume change material as defined within this section.
3. The upper 18" of material directly below the floor slabs (excluding granular leveling course or capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
   a. The upper 6 inches of the LVC layer shall be KDOT AB-3, crushed limestone/concrete screenings or asphalt millings.
4. The materials within 30" of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet of optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9" loose thickness and compacted to at least 95% but not more than 100% of the material's maximum dry density (ASTM D-698).
   a. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
1) Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content.
2) Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
3) Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
4) Granular soils should be placed at a workable moisture content.

b. In locations where moisture conditioning is not required, the upper 6” of exposed subgrade shall be scarified and recompacted to at least 95% of the material’s maximum dry density at moisture contents at least 3 percentage points wet of optimum.

5) All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.

6) Bedding Course:

7) Storm Sewer or Sanitary Sewer:
   a. Type 1 Pipe Bedding Material: Crushed Rock conforming to ASTM C-33, Gradation No. 67
   b. Type 2 Pipe Bedding Material: Sand-gravel mix conforming to KDOT Specifications for Type UD-2 underdrain aggregate.
   c. Type 3 Pipe Bedding Material: May be the same as Type 1 or 2 at the option of the contractor, or it may be a pit-run sand, or it may be select earth material which is free from stones larger than two inches in the longest dimension or trash and contains proper moisture content for compaction.

8) Waterline Pipe: Consists of sand placed from six inches (6”) under the barrel of the pipe extending to a level twelve inches (12”) above the top of the pipe.

Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

1. Sand: ASTM C-33; clean washed sand with one-hundred percent (100%) passing the ¾” sieve, not more than twenty-five percent (25%) retained on a No. 4 sieve and not more than ten percent (10%) passing the No. 200 sieve.
2. Low Volume Change (LVC) Material: Materials that have a liquid limit (LL) less than 40 and a plasticity index (PI) of at least 5 but less than 15. These materials may include granular soils (such as silty gravel, limestone/concrete screenings or clayey sand) or silty, sandy or lean clays.
3. Laboratory testing should be done on all prospective LVC materials to confirm their suitability prior to use.
4. Contractor may need to perform “wetting maintenance” in order to maintain the required above the optimum moisture content in the cohesive LVC material until construction of the floors.
5. LVC material should extend at least 5 feet beyond the edges of the proposed building.
6. Borrow Areas: Borrow areas provided by the contractor shall be approved by the Engineer as to suitability of material and location. Special care shall be taken in this approval to minimize the increase of siltation and turbidity of streams, lakes, and reservoirs and to avoid interference with the movement of migratory fish. Areas which, in the opinion of the engineer, leave an unsightly appearance to the Project will not be approved. All borrow sites must also be approved by the Kansas Department of Health and Environment.

Topsoil: Topsoil material shall be stripped (approximately 6” thick, see boring logs in Geotechnical Report) and stockpiled for use in final grading of the project. Any additional Topsoil needed for final grading of the project shall be previously stripped from the site or provided by the contractor at no additional cost.
2.2 CONTROLLED LOW-STRENGTH MATERIAL

Controlled Low Strength Material: Low-Density, self-compacting, flowable concrete material as follows:

1. Portland Cement: ASTM C 150, Type I or II.
2. Fly Ash: ASTM C 618, Class C or F.
5. Water: ASTM C 94/C 94M.
7. Produce low density, controlled low-strength material with the following physical properties:
8. As-Cast unit Weight: 120 lb./cu/ft. maximum at point of placement, when tested according to ASTM C 138/C 138M.
9. Compressive strength: 80 psi, when tested according to ASTM C 495.

2.3 ACCESSORIES

Silt Fence Fabric: Fine mesh material specifically designed to retain soil run-off, while maintaining surface drainage; comply with KDOT specs for materials to be used.

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils 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 deep; colored as follows:
   1. Red: Electric
   2. Yellow: Gas, oil, steam, and dangerous materials.
   3. Orange: Telephone and other communications.
   4. Blue: Water systems.
   5. Green: Sewer systems/Force mains

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades on all pipe lines that will transmit fluid by gravity flow with a slope less than one percent (1.00%).

C. Maintain grade alignment of other pipelines using string line parallel with grade line and vertically above centerline of pipe.
   1. Install batter boards spanning trench, rigidly anchored to posts driven into ground on both sides of trench.
   2. Determine elevation and position of string line from elevation and position of offset points or stakes located along pipe route.
3.2 PREPARATION

Verify field measurements prior to fabrication.

Call Local Utility Line Information service not less than five working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

Identify required lines, levels, contours, and datum locations.

Protect plant life, lawns, and other features remaining as portion of final landscaping.

Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

Maintain and protect above and below grade utilities indicated to remain.

Establish temporary traffic control and/or detours when trenching across roadways or streets. Relocate controls and reroute traffic as required during progress of Work.

Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions and deleterious materials from ground surface is specified in Division 31 Section “Site Clearing.”

Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

1. Temporary Erosion Control methods and materials shall be in accordance with the Contractor's Stormwater Pollution Prevention Plans (SWPP Plans) submitted for review and approval prior to construction of the project and the City of Topeka Standard Specifications.

Vegetation, topsoil, fill, existing structures and other loose, soft or otherwise unsuitable material should be removed from the planned paved areas at the on-set of construction. The procedures and recommendations in the Geotechnical Engineering Report shall be used. In addition to undercutting and moisture conditioning the existing site soils or replacing unsuitable existing soils (as required), all materials within the upper 24 inches of building floor slab subgrade level shall consist of low volume change material.

Strip all material classified as topsoil and miscellaneous fill in all disturbed areas; stripping shall be through the topsoil vegetation (or root zone).

1. Strip at least the upper 6” of existing materials.

Stockpile topsoil on-site for future use for finish grading.
1. The stockpile shall be surrounded with silt fence and temporarily seeded to prevent excessive erosion.

3.3 DEWATERING

Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.4 EXPLOSIVES

Explosives: Do not use explosives.

3.5 EXCAVATION, GENERAL

Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and disturbed material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins and Mechanical or Electrical Utility Structures:
4. Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Remove all fill material from within and at least 5 feet beyond the building footprint. Proofroll the exposed subgrades with a loaded tandem-axle dump truck or other heavy rubber-tired construction equipment weighing at least 20 tons to locate any zones that are soft or unstable.

1. Remove and replace any locations where rutting or pumping occurs during proofrolling or aerate/rework and re-compact in place to the specifications for Engineered Fill.

3.8 UNAUTHORIZED EXCAVATION

Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover or temporarily seed stockpiles to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2. Place silt fence around stockpiles to prevent excessive erosion and sediment loss.

3.10 EXCAVATION FOR UTILITY TRENCHES

A. TRENCHING EXCAVATION: The trench shall be excavated, true to line and grade as shown on the Plan or established by the Engineer. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the Plans or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid over-loading and to prevent slides or cave-ins. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and to maintain the flow of water in natural watercourses on or adjacent to the site. Any water accumulating in trenches or other excavations shall be removed by pumping or by other approved methods as specified elsewhere (see Section 3.3 – Dewatering). Unless otherwise indicated or authorized, excavation shall be by open cut.

1. Do not interfere with 45 degree bearing splay of foundations.

2. All excavated materials not required or suitable for backfill shall be removed and disposed of off the site, by and at the expense of the Contractor.

3. The Contractor shall not open more trench in advance of pipe laying than is necessary. Two hundred (200) feet will be the maximum length of open trench allowed on any line under construction. All open trenches shall be adequately protected.
4. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. TRENCH BOTTOMS: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade. Excavate to allow for bedding material where required.

C. LIMITING TRENCH WIDTHS AND PIPE CLEARANCES: Trenches shall be excavated to a width that will provide adequate working space and pipe clearances for proper pipe installation, jointing, bedding, and initial backfill operations.

   1. Trench walls shall be vertical from bottom of trench to twelve (12) inches above the top of pipe. Above that point, trench wall shall be sloped as required to meet safety standards and all pertinent OSHA Regulations. When Project conditions do not permit safe trench wall slopes, provide sheeting and shoring to protect excavation as specified in this section.

D. UNAUTHORIZED TRENCH WIDTHS: Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum specified above, either pipe of adequate design, total concrete pipe encasement, additional granular embedment or arch concrete encasements as required by loading conditions and as determined by the Engineer (at the Contractor's expense) shall be furnished and installed by and at the expense of the Contractor. The determination of necessary pipe, special embedment, or arch concrete encasement shall be based on a pipe strength equal to the minimum three-edge bearing ultimate strength stipulated in the governing pipe specifications for the size and kind of pipe involved with a safety factor of 65. Trench loadings will be based on saturated backfill weighing 120 (one hundred twenty) pounds per cubic foot with suitable allowance for truck or other live loads where required.

   1. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

E. EMBANKMENT OR FILL: When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with APWA section 2102.6 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the sewer trench.

F. MECHANICAL EXCAVATION: The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground; in all such locations, hand excavating tools and methods shall be used.

   1. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the control of the rough trench excavation bottom elevation is accurate and positive at all times, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench and that the trench alignment is such that the pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and side walls of the trench as excavated at all points. Undercutting of the sidewall to obtain such clearance will not be permitted.

   2. All mechanical trenching equipment, its operating condition, and the manner of its operations, shall be subject at all times to the approval of the Engineer.

G. BLASTING: The use of explosives is not allowed.

H. BELL HOLES: Excavation for bell holes for the various types of joints to be made, excavation for assembling and bolting mechanical joints or couplings, excavation in trench banks to provide
additional working space, and any other excavation outside of rough excavation limits which may be required for pipe jointing operations shall be performed prior to the installation of the specified bedding material below pipe subgrade elevations to prevent contamination of the bedding material.

1. Bell holes for mechanical joint pipe shall provide adequate clearance for the tools and methods used in installing and bolting the joints.

2. Bell holes for boltless gasketed joint pipe shall be excavated to provide at least one-inch clearance between the pipe bell and the bottom of the bell hole.

3. Excavations for the installation of Dresser type couplings on steel pipe shall have a length of twenty-six (26) inches parallel to the center line of the pipe, shall be centered on the middle of the joint, and shall provide a clearance of two (2) feet on the sides of an eighteen (18) inches below the bottom of the pipe.

4. Regardless of the type of joint, all excavations shall be of sufficient size and depth that the joints can be properly made and so that no part of the pipe bell, will be in contact with the trench bottom or pipe bedding thereon.

I. DEWATERING OF TRENCHES: Pipe trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing, and pipe encasement operations in an adequate and acceptable manner. Where the trench bottom is mucky or otherwise unstable because of the presence of ground water, and in all cases where the static ground water elevation is above the bottom of any trench or bell hole excavation, such ground water shall be lowered by means of well point and pumps or by other means acceptable to the Engineer, to the extent necessary to keep the trench free from water and the trench bottom stable at all times when work within the trench is in progress. The disposal of waste water from trench dewatering operations shall be subject to the approval of the Engineer at all times; such waste water shall be conducted to existing drainage ditches, channels, or drains. Surface water shall be diverted to prevent it from entering trenches.

1. See additional Dewatering instructions in Section 3.3 – Dewatering.

J. CUTTING CONCRETE PAVEMENT AND WALKS: Pipe lines constructed under paved roadways may be constructed by open cut trenching except at specific locations designated on the Plans where they shall be placed by boring, or a combination of boring and jacking. Brick pavement, concrete pavement and all types of concrete base pavement, may be removed or cut only where, in the manner, and to the extent specified herein or authorized by the Engineer. Cuts shall be no larger than necessary to provide adequate working space for proper installation of pipe and pipe line appurtenances. The cutting of pavements along each side of trenches and at structures shall saw cut. The saw cut shall be full depth of the pavement. Concrete pavement and walks shall be placed to existing joints.

1. Concrete pavement, brick and concrete base pavement over trenches excavated for pipe lines shall be removed to a width not less than twelve four (24) inches wider than the width of the trench at the pavement subgrade, which trench width shall not exceed the minimum permissible trench width for the size and type of pipe which is to be installed in the trench by more than twelve (12) inches. The trench width at the trench bottom shall not be greater than at the top and no under-cutting will be permitted. A shoulder not less than twelve (12) inches in width at any point shall be left between the cut edge of the pavement and the top edge of the trench. Pavement cuts shall be made to and between straight lines that, unless otherwise required, shall be parallel to the centerline of the trench.

2. Where the line of trench parallels the length of concrete walks and the trench location is all or partially under the walk, then the entire walk shall be removed and replaced. Crossings not more than eight (8) feet in length shall be accomplished by tunneling where the line of trench crosses concrete walks, curbs or gutters with approval of the engineer. If necessary to
remove concrete curbs, gutters or walks, they shall be replaced to and between existing joints.

K. UNPAVED ROAD CROSSINGS: Unpaved roads, driveways or streets may be crossed by trenching unless otherwise noted on the Plans. The Contractor shall install suitable barricades and lights at open trenches and take any precautions necessary to protect the public from damage and as required by the Owner. The Contractor will be financially responsible for any damage or suits arising from said crossings and shall save and hold harmless the Owner and the Engineer from any claims arising from this construction. The surface shall be replaced to permit prompt opening to traffic. The Contractor shall arrange his work to insure that streets, driveways, and roads be closed no longer than necessary for construction operations. Surfacing of unpaved streets, alleys, driveways and other traveled ways shall match existing surface depth and type of surface material.

L. EARTH EXCAVATION BELOW PIPE SUBGRADE: Pipe trenches shall be excavated below pipe subgrade elevations as shown on the Plans to provide for the installation of pipe bedding material as specified hereinafter.

M. PIPE CLEARANCE IN ROCK: Where rock is encountered in excavating and where it is necessary to place pipe in rock excavation, the rock shall be removed to provide a minimum clearance, for the size of the pipe being laid as set forth in the following table:

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Below Pipe</th>
<th>At Side of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>24&quot; and smaller</td>
<td>6&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>24&quot; to 36&quot;</td>
<td>9&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>42&quot; and larger</td>
<td>12&quot;</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>

1. The clearance figures given in the above table are minimum clearances from the closest projection of the rock to the outside edge of the pipe, and are not average figures. All material removed from the trench in order to provide the above-specified clearance shall be replaced below and at the sides of the pipe with approved backfill material. All replacement materials specified shall be furnished and installed by and at the expense of the Contractor.

N. TRENCH BOTTOM STABILIZATION: Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the Contractor, with one or more layers of crushed rock or other suitable material, where and as necessary to provide a firm and stable base for granular pipe bedding material. Not more than half-inch depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.

O. ARTIFICIAL FOUNDATIONS IN TRENCHES: Whenever so ordered by the Engineer, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with such material as the Engineer may order installed. All timber, concrete foundations, wooden inverts, pipes, posts, stringers, and/or saddles, made necessary by quicksand or other treacherous soil, shall be installed as directed by the Engineer. Compensation for extra excavation, timber, concrete, or other foundations, except where provided by Contract unit prices, shall be made in subsidiary to other bid items in the Contract.

3.11 SHEETING AND SHORING

A. TRENCH BRACING AND SHEETING: Except where trench banks are cut on a stable slope to prevent caving or sliding, trenches shall be properly and substantially braced, and sheeted if and where necessary, to prevent caving or sliding and to provide adequate protection to workmen and to the pipe line during and after the construction thereof. Sheetling shall not be pulled until after
the initial backfill is complete and then the space left from the sheeting shall be filled immediately and the backfill recompaected.

1. Fill voids with approved backfill material while shoring and bracing, and as sheeting is removed.

2. Where sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported by stakes driven into the trench bottom on each side of the pipe and with the tops of the stakes supported by cross braces above the top of the pipe or by other means, approved by the Engineer, which will not result in the application of concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe for the purpose of supporting sheeting in the bottom of the trench may be removed after the specified pipe embedment has been completed beyond the point of cross brace removal.

3. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

4. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.12 BACKFILL

Place and compact backfill in excavations promptly, but not before completing the following:

1. Proofroll exposed subgrades (under independent geotechnical agency supervision) with a loaded tandem-axle dump truck or other heavy, rubber tired construction equipment weighing at least 2 tons. Any unstable or soft zones exhibiting excessive pumping or rutting shall be removed and replaced or aerated/reworked and recompaected in place to the specifications for engineered fill.

2. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing and perimeter installation.

3. Surveying locations of underground utilities for Record Documents.

4. Testing and inspecting underground utilities.

5. Removing concrete formwork.

6. Removing trash and debris.

7. Removing temporary shoring, bracing and sheeting.

8. Installing permanent or temporary horizontal bracing on horizontally supported walls.

9. Backfill placed within building areas and in areas to be paved should consist of approved materials, which are free of organic matter and debris.

10. Place backfill on subgrades free of mud, frost, snow or ice.

11. Materials within 18 inches of the building floor slab subgrade level (excluding 4" granular leveling course) should be a select, low volume change (LVC) material (see Low Volume Change Materials in Section 2.1-Soil Materials).

12. The contractor shall evaluate the material within at least 30 inches of the bottom of the LVC layer just prior to placing any additional fill. Where the native materials within this zone at the start of construction are drier than 3 percentage points wet of the optimum moisture content, as determined by ASTM D-698, the materials shall be corrected (See Engineered Fill in Section 2.1-Soil Materials) or Section 3.14-Approval of Subgrade.

3.13 TRENCH BACKFILLING

A. TRENCH BACKFILL: The kinds of backfill materials to be used and the methods of placing and compaction shall conform to the requirements shown on the Plans and as described below. Employ placement method that does not disturb or damage foundation perimeter drainage and utilities in trench.
1. After each pipe has been graded, aligned and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to firmly hold and maintain the pipe in proper position and alignment during subsequent pipe jointing, embedment and backfilling operations.

2. Pipe embedment material, in each case, shall be deposited in the trench in such manner that it is scattered along the sides of the pipe and not dropped in compacted masses. In addition, such material shall be deposited, and compacted where required, uniformly and simultaneously on each side of the pipe in order to prevent lateral displacement of the pipe.

3. Drainage maintenance: Backfilling of trenches for pipe installed beneath and/or across roadways, driveways, walks and other traffic ways adjacent to drainage ditches and water courses shall not be done prior to the completion of backfilling to the original ground surface of the trench on the upstream side of such trafficway in order to prevent the impounding of water at any point after the pipe has been laid, and all necessary bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained. Backfilling shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.

4. Protection of trench backfill in drainage courses: Where trenches are constructed in or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion by adequate means.

5. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

6. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

7. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

8. Coordinate backfilling with utilities testing.

9. Place and compact final backfill of satisfactory soil material to final subgrade.

10. Install warning tape directly above utilities, 12 inches (min.) - 30 inches (max.) below finished grade.

B. EMBANKMENT OR FILL: When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with APWA section 2102.6 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the sewer trench.

C. BACKFILL MATERIALS AND PLACEMENT

1. Bedding Course:

2. Storm Sewer or Sanitary Sewer:
   a. Type 1 Pipe Bedding Material: Crushed Rock conforming to ASTM C-33, Gradation No. 67
   b. Type 2 Pipe Bedding Material: Sand-gravel mix conforming to KDOT Specifications for Type UD-2 underdrain aggregate.
c. Type 3 Pipe Bedding Material: May be the same as Type 1 of 2 at the option of the contractor, or it may be a pit-run sand, or it may be select earth material which is free from stones larger than two inches in the longest dimension or trash and contains proper moisture content for compaction.

3. Waterline Pipe: Consists of sand placed from six inches (6”) under the barrel of the pipe extending to a level twelve inches (12”) above the top of the pipe.

4. Pipe Embedment and Backfill
   a. Sanitary/Storm Pipe:
      1) Rigid Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level equal to one-sixth (1/6) of the outside pipe diameter. Type 3 pipe bedding material shall be used from this level to a level twelve inches (12”) above the top of the pipe.
      2) Flexible Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level twelve inches (12”) above the top of the pipe.
      3) Semi-Rigid Pipe: Bedding course shall consist of Type 1 or 2 pipe bedding material under the barrel of the pipe extending up to a level equal to one-half (1/2) of the outside pipe diameter. Type 3 pipe bedding material shall be used from this level to a level twelve inches (12”) above the top of the pipe.
   b. Waterline Pipe:
      1) Bedding course for waterline pipe shall consist of sand placed from six inches (6”) under the barrel of the pipe extending to a level twelve inches (12”) above the top of the pipe.
      2) Final Backfill:
         a) All final backfill under building or paved areas shall be select backfill.
         b) The top portion of backfill beneath established sodded areas shall be finished with not less than six (6) inches of topsoil.
         c) Backfill trenches to contours and elevations with unfrozen fill materials.
         d) Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
         e) Do not leave more than 50 feet of trench open at end of working day.
         f) Place fill material in continuous layers and compact in accordance with COMPACTION SECTION.
         g) Protect open trench to prevent danger to the public.

D. UNSUITABLE BACKFILL MATERIAL: No material shall be used for trench backfill which contains rocks or clogs greater than two (2) inches in any dimension, frozen material, debris, junk, or organic material. Such material shall be removed from the backfill and deposited at the direction of the Engineer.

E. DISPOSAL OF EXCESS EXCAVATED MATERIALS: Except as otherwise permitted, all excess excavated materials shall be disposed of away from the work and at a site approved by the Engineer.

   1. Broken concrete and other coarse debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work and at a site approved by the Engineer.

   2. The disposal of waste and excess excavated materials, including all hauling, handling, and spoil bank leveling and surfacing shall be a subsidiary obligation of the Contractor and the full cost thereof shall be considered as being included in and fully covered by other items in the contract.

F. PROTECTION OF TREES AND SHRUBBERY: No trees shall be removed except where their removal is shown on the Plans or is authorized by the Engineer. Main tree roots shall not be cut except where they fall within the area to be occupied by the pipe. Excavation shall be done by hand...
where necessary to prevent injury to roots or trees. Trees that are left standing shall be adequately protected from permanent damage by reason of construction operations. Trimming of standing trees where required shall be as directed by the Engineer. All shrubbery outside of the construction limits, which is damaged or removed by the Contractor, shall be replaced under the direction of and to the satisfaction of the Owner, by and at the expense of the Contractor.

G. INTERRUPTION OF TRAFFIC: Interruption to through traffic on streets and roads will be kept to a very minimum and provisions shall be made to permit local traffic to serve residences in the vicinity of the work at all times.

H. REMOVAL AND REINSTALLATION OF ITEMS: Street signs, street stop signs, mail boxes and other existing items noted on the Plans or found within construction limits shall without damage be removed, stored, and reinstalled in a condition comparable to pre-existing condition prior to construction. No separate payment will be made for those items but shall be considered subsidiary to other pay items in the Proposal.

3.14 APPROVAL OF SUBGRADE

A. Notify Geotechnical Engineer when excavations have reached required subgrade. This includes within building area prior to placement of all fill materials.

B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

Proof roll subgrade beneath building slabs and pavements with a tandem-axle dump truck (with geotechnical engineer present) to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

1. Tandem-axle truck shall be a minimum of 20 tons gross weight.

Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer. In areas where reconstruction or reworking of the subgrade is required due to unstable conditions, unsuitable soils, or as indicated on the drawings, the Contractor shall undercut the area to a stable and firm strata and backfill as directed by the Geotechnical Engineer. Backfill shall be accomplished in not more than 9-inch lifts with soil meeting the requirements of satisfactory material and compacted as noted below. The contractor must meet the following density and moisture requirements:

1. Satisfactory soils:
   a. Compacted to at least 95% but not more than 100% of standard proctor maximum density. (ASTM D-698)
   b. Moisture content is 0 to 3% above optimum. (ASTM D-698)
   c. Paved Areas: Upper 8 inches of exposed subgrade (prior to final compacted subgrade layer identified in the pavement sections see Subsection 3.16.G below) and all additional fill
   d. Compacted to at least 95% of standard proctor maximum density (ASTM D-698)
   e. Above optimum moisture content (ASTM D-698).

2. The upper 18" of material directly below the floor slabs (excluding 4" granular leveling course or capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
   a. The upper 6 inches of the LVC layer shall be KDOT AB-3, crushed limestone/concrete screenings or asphalt millings.
   b. LVC layer shall extend at least 5’ horizontally outside of the building footprint.
3. The materials within 30" of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet of optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9" loose thickness and compacted to at least 95% but not more than 100% of the material’s maximum dry density (ASTM D-698).

4. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
   a. Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content.
   b. Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
   c. Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
   d. Granular soils should be placed at a workable moisture content.

5. In locations where moisture conditioning is not required, the upper 6" of exposed subgrade shall be scarified and recompacted to at least 95% of the material’s maximum dry density at moisture contents at least 3 percentage points wet of optimum.

6. All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.

   If the soils do not have to be reworked or replaced, the top 6-inches of soil shall be reworked and compacted to 95 percent standard density and at least 0 percent to plus 3 percent of optimum moisture content.

3.15 SOIL FILL

Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

Plow, scarify, bench or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

Prior to placing fill, the existing grade shall be inspected by the geotechnical engineer. All materials within 30 inches of the bottom of the low volume change material must be evaluated for moisture content and stability. If the soils are satisfactory soils drier than 0 percent to 3 percent wet of optimum (ASTM D-698) the soils will have to be reworked to be at least 0 percent to 3 percent above optimum (see Engineered Fill in Section 2.1 Soil Materials). The soils shall be reworked and replaced in not to exceed 9-inch lifts between 95 to 100 percent of standard density and at least 0 percent to plus 3 percent moisture. If the soils do not have to be reworked or replaced, the top 6-inches of soil shall be reworked and compacted to between 95 percent and 100 percent of standard density and at least 0 percent to 3 percent above optimum moisture content.

Place and compact fill material as defined in Section 3.16 "Compaction of Backfills and Fills".

Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill
   5. Under footings and foundations, use engineered fill.
Fill placed within building areas and in areas to be paved should consist of approved materials, which are free of organic matter and debris.

Materials within 18 inches of the building floor slab subgrade level (excluding granular leveling coarse or capillary moisture break) should be a select, low volume change material.

3.16 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to the requirements in this report.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.17 COMPACTION OF UTILITY TRENCHES

A. Prior to the placement of either structure backfill or trench backfill, a Standard Proctor Curve as determined by AASHTO T 99 (ASTM D 698) shall be obtained for each type of backfill material to be used.

1. Proctor curves shall be obtained from soil samples selected by a certified testing laboratory from materials excavated by the Contractor.

2. All costs associated with the selection of soil samples and performing the necessary tests to obtain the Proctor curves shall be paid by the Contractor.

3. Selection of the correct Proctor curve for a particular backfill material shall also be done by the Contractor’s certified testing laboratory.

4. During backfill operations, soil density tests shall be taken by the Engineer or his representative. When results indicate that compaction does not meet the requirements of these Specifications, the material shall be removed and replaced or re-compacted as necessary to meet the specified requirements at no additional expense to the City. Additional tests shall be performed on re-compacted area to insure compliance with the requirements.

B. Compacted backfill material shall be placed in layers and compacted by means of suitable equipment or by tamping with mechanical tampers or hand tampers.

1. Place and densify embedment material by shovel slicing or vibrating and prepare embedment material so that the pipe will be true to line and grade after installation.

2. After each pipe has been brought to grade, aligned, and placed in final position, deposit and densify by shovel slicing sufficient bedding material under the pipe haunches and on each side of the pipe to hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations. Place bedding material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

C. Compacted backfill within two (2) feet of water valve boxes, wyes, and riser pipes shall be hand tamped. Compacted backfill within five (5) feet of sanitary sewer manholes and storm sewer structures shall be hand tamped. Ditch plugs at the pipe outlet and at interval points constructed to the limits specified herein shall be compacted to Type A compaction as specified in this section.
D. All hand placed backfill shall be deposited and spread with hand tools in uniform layers not more than eight (8) inches in thickness on each side of the pipe and for the full width of the trench where above the pipe.

E. **TYPE A COMPACTION**: Each layer shall be compacted to a density equal to or greater than 95% (ninety-five percent) maximum density. Each successive layer shall contain only the amount of material which will insure proper compaction, but in no case shall any layer be greater than eight (8) inches (loose measurement). The moisture content of the soil to be used for backfill shall be uniform and shall be within plus or minus two percentage points of optimum moisture for the soil.

1. Type A Compaction shall be use under all pavements, sidewalks, curb and gutter, stairs, railings, and structures or buildings or as designated on the plans.

2. The contractor shall certify that 98% (ninety-eight percent) compaction has been achieved. Results of tests performed shall be submitted to the Engineer.

3. Testing frequency shall be at each compacted initial and final backfill layer at least one test for each 150 feet or less of trench length, but no fewer than two tests per layer.

   a) Additional testing shall be taken at the recommendation of the engineer or in areas where compaction of trench initial or final backfill is in question.

4. Where applicable, Type A compaction shall begin and end a minimum of 1’ behind the back of curb or edge of pavement on street or pavement crossings.

5. The maximum density of the soil shall be determined by ASTM designation: D698. The test to determine the maximum density of the soils (Standard Proctor) shall be performed by an approved testing laboratory without cost to the Owner.

6. Backfill shall be composed of selected excavated material or approved borrow material.

7. Flowable Fill: A controlled low-strength material (flowable fill) may be substituted for Type A compaction. The materials used shall be the following in the approximate quantities per cubic yard:

   - Cement 100 lbs./Type 1
   - Water ........................................................................................................................370 lbs.
   - Fine Aggregate ..............................................................................................3,400 lbs., 100% smaller than half inch; 0 to 10% smaller than No. 200 sieve.

   a) These proportions may be field adjusted to provide a fill that readily flows around the pipe. The fill shall be placed on both sides of the pipe simultaneously so that both sides are kept approximately equal. The pipe shall be secured in place against floatation and movement prior to placement of the fill to secure. The fill shall be placed to the bottom of the pavement to be placed over the trench.

F. **TYPE B COMPACTION**: Type B Compaction shall be used in all other areas not requiring Type A compaction as stated in this specification or as designated in the plans.

1. Type B Compaction shall be placed in layers and compacted by means of suitable equipment or by tamping with mechanical tampers or hand tampers. Each layer shall be compacted to a density equal to or greater than 90% (ninety percent) maximum density. Each successive layer shall contain only the amount of material which will insure proper compaction, but in no case shall any layer be greater than eight (8) inches (loose measurement). The moisture content of the soil to be used for backfill
shall be uniform and shall be within plus or minus two percentage points of optimum moisture for the soil.

2. The Contractor shall certify that 90% (ninety percent) compaction has been achieved. Results of tests performed shall be submitted to the Engineer.

3. Testing frequency shall be at each compacted initial and final backfill layer at least one test for each 50 linear feet of trench.
   a) Additional testing shall be taken at the recommendation of the engineer or in areas where compaction of trench initial or final backfill is in question.

3.18 COMPACTION OF SOIL BACKFILLS AND FILLS

1. Place fill and backfill materials in layers not more than 9 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

2. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

3. Backfill against structures shall be granular soils (extending out from the base of the wall at an angle of at least 45 degrees) or low plasticity soils.

4. The upper 18” of material directly below the floor slabs (excluding 4” granular leveling course or capillary moisture break) shall consist of a Low Volume Change (LVC) layer.
   a. The upper 6 inches of the LVC layer shall be KDOT AB-3, crushed limestone/concrete screenings or asphalt millings.
   b. Soils shall be placed in not more than 9” loose thickness and compacted to at least 95% but not more than 100% of the maximum dry density.
   c. LVC layer shall extend at least 5’ horizontally outside of the building footprint.

6. The materials within 30” of the bottom of the LVC layer shall be evaluated just prior to placement of additional fill for moisture content. Should the materials be drier than 3 percentage points wet op optimum moisture content (ASTM D-698), the materials shall be removed and replaced uniformly with moisture content at least 3 percentage points wet of optimum. The replacement should occur in no more than 9” loose thickness and compacted to at least 95% but not more than 100% of the material’s maximum dry density (ASTM D-698).

7. The minimum moisture content at which the engineered fill below the LVC layer should be placed will be as follows:
   a. Cohesive soils with a plasticity index (PI) greater than 25 should be placed at a moisture content of at least 3 percentage points wet of optimum moisture content
   b. Cohesive soils with a PI greater than 20 should be placed at a moisture content of at least 2 percentage points wet of optimum moisture content.
   c. Cohesive soils with a PI less than 20 should be placed at a moisture content above their optimum moisture content.
   d. Granular soils should be placed at a workable moisture content.

8. In locations where moisture conditioning is not required, the upper 6” of exposed subgrade shall be scarified and re-compacted to at least 95% of the material’s maximum dry density at moisture contents at least 3 percentage points wet of optimum.
9. All engineered fill sections should extend at least 5 feet (horizontally) outside of the edges of the building footprint.

10. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

<table>
<thead>
<tr>
<th>Subgrade Material</th>
<th>Density Requirements</th>
<th>Moisture Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfactory soils</td>
<td>95 – 100 percent (ASTM D-698)</td>
<td>0 to +3 percent</td>
</tr>
<tr>
<td>Subgrade Preparation</td>
<td>95 – 100 percent (ASTM D-698)</td>
<td>0 to +3 percent</td>
</tr>
<tr>
<td>Low volume change</td>
<td>95 – 100 percent (ASTM D-698)</td>
<td>0 to +3 percent</td>
</tr>
<tr>
<td>Pavement Subgrade**</td>
<td>98 – 100 percent (ASTM D-698)</td>
<td>0 to +3 percent</td>
</tr>
</tbody>
</table>

** see additional info in sections below

In areas to be paved, the upper 8" of native soil (after removal of vegetation/organic material and topsoil) shall be proofrolled as described in section 3.13.C. The upper 8" of the exposed subgrade shall be compacted to at least 95% of the maximum dry density (ASTM D-698) and above optimum moisture content prior to placement of additional fill. All additional fill shall be placed in 9" loose thickness and compacted to at least 95% of maximum dry density and above optimum moisture content.

The final 8" of subgrade directly beneath flexible pavements shall be compacted to at least 98% of standard proctor maximum dry density.

The final 18" of subgrade directly beneath rigid, concrete pavements and exterior slabs shall meet the requirements of Subsection D above (3.16.D)

The exposed subgrade and each lift of compacted fill shall be tested, evaluated and reworked as necessary until approved by the geotechnical engineer prior to placement of additional fill.

Each lift of fill shall be tested for density and moisture content at a frequency of one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in the pavement areas.

3.19 STORM WATER POND LINERS

A. In order to limit seepage from storm water wet pond(s), earthen liners of approved clay shall be placed as follows:

1. Construct an earthen liner along the bottom and sides of the wet pond to a thickness of 12 inches.

2. The 12 inch thick layer shall consist of approved fat clay soils with a plasticity index of at least 25, as indicated by laboratory Atterberg Limits tests of samples of the completed liner.

   a) The liner materials shall be free of organic and deleterious materials, with compacted lifts not to exceed 6 inches in thickness, adjusted in moisture content to between zero and 4 percentage points above the optimum moisture content and compacted to a minimum of 95% of the maximum dry density (ASTM D-698). The moisture content and compaction should be maintained in the earthen liner until after the initial fill of the wet pond.
b) Fill materials used to construct the embankment should be free of organic materials and debris and placed in lifts not to exceed 9" loose thickness and shall be compacted to at least 95% of the standard proctor maximum dry density at moisture contents within 2 percentage points of the optimum (ASTM D-698).

3. During liner construction, field moisture and density testing and Atterberg Limits testing should be conducted to evaluate the suitability of the proposed liner materials. The exposed subgrade and each lift of compacted fill shall be tested, evaluated and reworked as necessary until approved by the Geotechnical Engineer, prior to placement of additional lifts.

   a) Each lift of fill shall be tested for density and moisture content at a frequency of at least one test per acre of compacted fill in the storm water wet pond areas.

   b) The Contractor shall test the permeability of relatively undisturbed tube samples from the constructed liner.

3.20 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

   1. Provide a smooth transition between adjacent existing grades and new grades.

   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

   1. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.
3.21 SUBBASE AND BASE COURSE

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
   1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place base course material over subbase course under hot-mix asphalt pavement.
   3. Shape subbase and base course to required crown elevations and cross-slope grades.
   4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
   5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders at least 12 inches wide of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.22 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Place drainage course 6 inches or less in compacted thickness in a single layer.
   3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.23 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing as stated in section 1.5 QUALITY ASSURANCE.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 sq. ft. or less of building slab and 5,000 sq. ft. or less of pavement areas, but in no case fewer than three tests.

2. Trench Backfill: At each compacted initial and final backfill layer at least one test for each 50 linear feet or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.24 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Geotechnical Engineer: reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 2000
SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. Section Includes:

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.
   B. Soil Treatment Application Report: Include the following:
      1. Date and time of application.
      2. Moisture content of soil before application.
      3. Termiticide brand name and manufacturer.
      4. Quantity of undiluted termiticide used.
      5. Dilutions, methods, volumes used, and rates of application.
      6. Areas of application.
      7. Water source for application.
   C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, and ground-supported slabs before construction.

1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity or damage is
discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product’s EPA-Registered Label.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Corporation, Agricultural Products; Termidor.
   b. Bayer Environmental Science; Premise 75.
   c. FMC Corporation, Agricultural Products Group; Prevail.
   d. Syngenta; Demon MAX.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer’s written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termicidies may be applied before placing compacted fill under slabs if recommended in writing by termicide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.
3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.

2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.

3. Crawlspace: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.


5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Post warning signs in areas of application.

D. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116
SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

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 temporary excavation support and protection systems.

1.3 PERFORMANCE REQUIREMENTS
   A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

   1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Prevent surface water from entering excavations by grading, dikes, or other means.
   3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

1.4 SUBMITTALS
   A. Shop Drawings: For excavation support and protection system.
   B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   C. Coordinate first paragraph below with qualification requirements in Division 01 Section "Quality Requirements." Qualification Data: For qualified land surveyor and professional engineer.
   D. Other Informational Submittals:

      1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
      2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
         a. Note locations and capping depth of wells and well points.
1.5 QUALITY ASSURANCE


1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:

   a. Geotechnical report.
   b. Existing utilities and subsurface conditions.
   c. Proposed excavations.
   d. Proposed equipment.
   e. Monitoring of excavation support and protection system.
   f. Working area location and stability.
   g. Coordination with waterproofing.
   h. Abandonment or removal of excavation support and protection system.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

E. Shotcrete: Comply with Division 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinfocing Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. Tiebacks: Steel bars, ASTM A 722/A 722M.

I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
   1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed
faces of flanges to vary not more than [2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment]

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than [2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment]. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000
SECTION 32 1313 – CONCRETE PAVING

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 exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Curbs and gutters.
3. Walkways.

B. Furnish materials, workmanship, and other requirements in accordance with KDOT standards and specifications except as revised by these plans and specifications.

C. Related Sections include the following:

1. Division 312000 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
2. Division 321373 Section "Concrete Paving Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix. Include contingent mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Bonding agent or adhesive.

E. LEED Submittals

1. Recycled Content- Credit MR 4.2: Provide documentation indicating percentages of post-consumer and pre-consumer recycled content by weight per unit of product or assembly containing the product. Indicate the percentage of the dollar value of the recycled content compared to the total dollar value of the product or assembly containing the product.
2. Regional Material- Credit MR 5.2: When the distance to the project site is 500 miles or less, indicate location and distance to project site of extraction, harvesting, recovery, and manufacturing of all materials. Indicate the dollar value of the material cost of the product containing local/regional materials. Where product components are sourced or manufactured in separate locations, provide location and percentage by weight of each component per unit of product.
3. Solar Reflective Index – Credit SS 7.1: Provide documentation indicating Solar Reflective Index (SRI) of indicated Concrete Mixes is a minimum of 29 as certified by a testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.


F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

G. Codes and Standards: Comply with local governing regulations if more stringent that requirements herein specified.
1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. Steel wire and steel supports used in conjunction with epoxy coated steel reinforcement shall be epoxy coated or plastic coated.

2.3 CONCRETE MATERIALS
A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I except that total alkali contents shall not exceed 0.60 percent.
   1. Fly Ash will be permitted to the proportions defined within this specification.

C. Fly Ash: ASTM C 618, Class C or Class F
   1. Loss on ignition not to exceed 3.0%
   2. Expansion of the test mixture as a percentage of low alkali cement control at 14 days <120%.
   3. Minimum sampling and testing frequencies per ASTM C 311.
   4. Source of Fly Ash must be on the KDOT Pre-qualified list.

D. Aggregate: All aggregates shall conform to the requirements of KDOT Specifications, latest edition, except where otherwise provided by these specifications.
   1. All aggregates shall have been tested to show no evidence of alkali-silica reactivity (ASR) contributing to deleterious concrete expansion when tested in accordance with C227 as used in the actual design mix.

E. Coarse Aggregate: ASTM C 33, uniformly graded from a single source, as follows:
   1. Gravel, crushed gravel, crushed stone or a combination thereof.
   2. The percentage of wear shall not exceed forty percent (40%) as tested by the Los Angeles Abrasion Test Method and the loss shall not be more than eighteen percent (18%) as tested for soundness by the Magnesium Sulfate Method. The soundness requirement shall be waived if aggregate meets all of the requirements for Durability Class I of the KDOT Standard Specification.
   3. Maximum absorption of three and five tenths percent (3.5%).
   4. Grading Requirements shall be size No. 67, ¾” to No. 4:

<table>
<thead>
<tr>
<th>Retained on 1&quot; mesh sieve</th>
<th>Retained on 3/4&quot; mesh sieve</th>
<th>Retained on 3/8&quot; mesh sieve</th>
<th>Retained on #4 mesh sieve</th>
<th>Retained on #8 mesh sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%-10%</td>
<td>45%-80%</td>
<td>90%-100%</td>
<td>95%-100%</td>
</tr>
</tbody>
</table>

   5. Course Aggregates for Entrances within the City of Topeka Right-of-Way shall conform to City of Topeka Specifications for Pavement Class-A. Pavement Class-A course aggregate is entirely granite, quartzite, or trap rock. See City of Topeka Specifications. This requirement applies to entrances and valley gutters in the right-of-way, and not sidewalks.

F. Fine Aggregate: Fine Aggregate to be used in concrete shall consist of natural sand resulting from the disintegration of siliceous and/or calcareous rocks and manufactured sand produced from crushing predominantly siliceous materials and shall be uniformly graded from coarse to fine. This type of aggregate shall be free from injurious amounts of organic impurities and from injurious amounts of alkali. Other deleterious substances shall not exceed the following percentages by weight:

<table>
<thead>
<tr>
<th>Material passing No. 200 sieve</th>
<th>Shale, lignite, coal, soft or flaky fragments</th>
<th>Sticks (wet)</th>
<th>Clay lumps (wet, on No. 4 sieve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>1.0</td>
<td>0.1</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Fine Aggregate shall meet the following gradation requirements when tested as specified by ASTM Method C 136:

| Retained on 3/8" sieve | 0%  
| Retained on 3/8" sieve | 0%-5%  
| Retained on 3/8" sieve | 0%-20%  
| Retained on 3/8" sieve | 15%-50%  
| Retained on 3/8" sieve | 40%-75%  
| Retained on 3/8" sieve | 70%-95%  
| Retained on 3/8" sieve | 90%-100%  

1. The fine aggregate shall have a fineness modulus of not less than 2.50 or more than 3.40 and the percent retained between any two consecutive sieves shall not be more than twenty-five percent (25%).

G. Water: ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.


C. Water-Reducing Admixture: ASTM C 494, Type A.

2.5 CURING MATERIALS

A. A liquid membrane-forming curing compound shall be used for all applications, unless otherwise specified by the Engineer. The compound shall conform to the requirements for Type 2, white Pigmented Compound as specified in AASHTO M 148 and to the requirements of ASTM C 309.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. All newly placed concrete shall be cured immediately after finishing for a minimum of 7 days unless otherwise specified or approved by the Engineer. Formed surfaces shall be cured if forms are removed prior to 7 days after concrete placement.

2.6 AGGREGATE BASE COURSE

A. Aggregate Base Course shall consist of KDOT AB-3 in accordance with Division 1100, Section 1104 “Aggregates for Aggregate Base Construction” of the KDOT “Standard Specifications for the State Road and Bridge Construction”, latest edition.

B. Aggregate Base shall be constructed in accordance with KDOT Division 300, Section 305 “Aggregate Base and Aggregate Shoulders” of the KDOT “Standard Specifications for the State Road and Bridge Construction”, latest edition.

C. Aggregate Base thickness to meet the specified minimum thickness indicated on the plans.
D. Aggregate Base shall extend 1 foot outside of the back of curb or 1’ outside of the edge of concrete pavement.

2.7 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 CONCRETE MIXES

A. The concrete mixture shall be formulated such that the hardened/cured concrete shall have a solar reflectance index of at least 29.

B. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

   1. City Mix as detailed in the City of Topeka Standard Specifications.

C. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

   1. Do not use Owner's field quality-control testing agency as the independent testing agency.

D. Proportion mixes to provide concrete with the following properties:


E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

   1. Fly Ash shall be Type C or Type F with a minimum of 20% and a maximum of 25% by unit weight.

F. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain portland cement replacements, to determine amount of portland cement replaced.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 2 percent:

   1. Air Content: 6.0 percent.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.
PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
3. Provide tie bars at sides of pavement strips where indicated.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
   1. Locate expansion joints at ends of curb returns and changes in curb direction.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Install dowel bars and support assemblies at joints where indicated. Paint and grease approx. three-fifths of dowel length to prevent concrete bonding to one side of joint.
   1. Alternate ends of dowels in baskets to be painted and greased.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   1. Space joints at fifteen (15') feet maximum or as noted on the plan set.
   2. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
   3. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
   1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Install reinforcement as per one of the following methods:

   1. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
      a. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by Engineer.
   2. Set welded wire fabric or fabricated bar mats on bar supports as specified in this section or concrete blocks of required height.

I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

N. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screening, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Re-float surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
   a. Broom finish not applicable to curb & gutter

3.7 CONCRETE PROTECTION AND CURING
A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.

B. Aggregate Base

1. Elevation: No Plus Allowed, Minus ½ inch
2. Thickness: Plus ½ inch, No Minus Allowed

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing shall be performed according to the following requirements:
1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.

3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.

5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

7. When frequency of testing will provide fewer than five compressive-strength tests 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 are used.

8. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.

10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.

E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION
A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for inspections.

END OF SECTION 32 1313
SECTION 32 1373 – CONCRETE PAVING JOINT SEALANTS

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. Expansion and contraction joints within portland cement concrete pavement.

B. Furnish materials, workmanship, and other applicable requirements in accordance with City of Topeka standards and specifications except as revised by these plans and specifications.

C. Related Sections include the following:
   1. Division 32 Section "Concrete Paving" for constructing joints in concrete paving.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: Match Architect's samples or as selected by Architect from manufacturer's full range for this characteristic.

C. Joint Filler: For expansion joints, filler shall be preformed joint filler conforming to ASTM Designation D1751.

2.2 HOT-APPLIED JOINT SEALANTS

A. All joints shall be sealed with hot-pour type joint sealant meeting the requirements of ASTM 1190.

2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining and heat resistant; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. The backer rod shall be resilient closed or open cell polyethylene foam rod as recommended by the manufacturer of the sealant. It shall be compatible with the silicone sealant and no bond or reaction shall occur between the rod and the sealant.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of backer materials.
   2. Do not stretch, twist, puncture, or tear backer materials.
   3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.

F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.
3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 1373
SECTION 32 9200 TURF AND GRASSES

PART 1: GENERAL

1.1 DESCRIPTION

This section describes the establishment of turf and the restoration of existing lawn or turf areas that are disturbed during construction or repair & maintenance activities. In general disturbed surfaces will be restored to conditions equal to or better than what they were before the work began.

1.2 SUBMITTALS

A. Manufacturer’s product data:
   1. Complete materials list of all materials proposed to be furnished and installed under this section
   2. Specifications and other data required to demonstrate compliance with the specified requirements.

B. Pre-Construction Photos
   1. Provide pre-construction photos of the existing conditions prior to disturbance of proposed areas of construction.

1.3 GUARANTEE

A. If a satisfactory stand of lawn/grass has not been produced, the Contractor shall renovate and reseed the lawn and unsatisfactory portions thereof immediately or during the next planting season if proper weather conditions do not exist. A satisfactory stand is defined as a section of lawn that has:
   1. For lawn areas
      a. No bare spots larger than 3 square feet.
      b. Not more than 10 percent of total area with bare spots larger than 1 square foot
   2. For non-lawn (turf) areas
      a. No bare spots larger than 4 square feet
      b. The restored turf generally matches the coverage of the surrounding undisturbed turf area
1.4 REFERENCES

FS O-F-241 Fertilizers, Mixed, Commercial (09 Oct 90) JJJ-

S-181b Seeds, Agricultural (08 Feb 91)


1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspection – Inspect turf material upon arrival and remove unacceptable material from the job site.

B. Fertilizer - Deliver to the site in original unopened containers bearing manufacturers chemical analysis.

C. Seed and fertilizer shall be stored in cool, dry locations away from contaminants.

D. Handling - Except for bulk deliveries do not drop or dump materials from vehicles.

PART 2: PRODUCTS

2.1 SEED

A. Seed Classification - Provide USDA certified seed of the latest seasons crop in original sealed packages bearing the producers guaranteed analysis for mixture percentage, purity, germination, weed seed content, and inert material. Label in conformance with USDA-01 and applicable state seed laws.

B. Quality Requirements - All seed must meet the requirements of the Kansas Seed Law including the labeling requirements for showing pure live seed (PLS = purity x germination), name and type of seed.

2.2 FERTILIZER

A. Fertilizer shall be commercial grade, uniform in composition and conforming to Federal Specification O-F-241. Fertilizer shall be Type I or Type II

B. Fertilizer shall be lawn or turf grade containing a minimum of 1lb nitrogen, 1lb phosphate, 1lb pot-ash active ingredient per 1000 SF (unless soil tests are conducted and suggest otherwise) Water soluble fertilizer must be used in hydroseeding.
2.3 TOPSOIL

A. When possible native topsoil excavated from a construction site will be stockpiled and reused on the same site. When topsoil must be imported to the site it shall come from locally approved Kansas sources.

B. Topsoil shall be local, fertile, friable, natural, productive surface soil as is available on site. It shall be free of clay, stones or similar hard objects larger than 1 inch in greatest dimension and free of partially disintegrated debris and materials that are toxic or harmful to growth. Acceptable topsoil will contain organic matter in range of 1.5 percent to 20 percent.

2.4 SOIL EROSION CONTROL BLANKETS

A. When or if required for use soil erosion control blankets shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either plastic netting or twisted Kraft paper cord netting. Soil erosion control blankets shall not be installed on flat surfaces and sloped surfaces up to and including 10:1 slopes. Soil erosion control blankets shall be used on surfaces with a slope greater than 10:1 as per the manufacturers installation guidelines.

B. Erosion control compost matting and Erosion Control Compost may also be used as an equivalent to erosion control blanket.

C. Erosion Control Compost shall follow City of Topeka’s specifications within City of Topeka’s right of way.

2.5 HYDROSEED AND SOD

A. Lawn Areas (greater than 400 SF)

Hydroseed areas where lawns are or have been regularly maintained, whether residential, commercial or office areas, with the following mixture.

*Bermuda grass - 2lb per 1000 SF (use hulled seed in non-growing season)*
*Annual Ryegrass - 5lb per 1000 SF*
*Water soluble fertilizer (minimum 1lb Nitrogen, 1lb Phosphate, and 1lb Pot Ash per 1000 SF)*
*Flexterra HP-FGM (applied per Profile’s loading chart 3000lb/acre)*

B. Non-Lawn (Turf) areas greater than 400 SF

Hydroseed areas with the following mixture or a mixture as specifically required by the governing authority other than AW.
Bermuda grass - 2lb per 1000 SF (use hulled seed in non-growing season)
Annual Ryegrass - 5lb per 1000 SF
Water soluble fertilizer (minimum 1lb Nitrogen, 1lb Phosphate, and 1lb Pot Ash per 1000 SF)
Flexterra HP-FGM (applied per Profile’s loading chart 3000lb/acre)

C. Lawn or Non-Lawn (Turf) areas less than 400 SF

For areas to be restored that are less than 400 SF sodding or traditional hand or machine fertilizer and seed broadcasting methods may be used. Fertilize and seed areas with the following mixture.

Bermuda grass - 2lb per 1000 SF (use hulled seed in non-growing season)
Annual Ryegrass - 5lb per 1000 SF
Water soluble fertilizer (minimum 1lb Nitrogen, 1lb Phosphate, and 1lb Pot Ash per 1000 SF)

Sod (Bermuda or St Augustine) will be used that matches the existing turf. Where sod is used it shall be green, freshly cut, and of good quality with grass free from all noxious weeds. It shall contain all the dense root system of the grass and shall not be less than 1-1/2 inches thick.

2.6 MULCH

A. If used mulch shall be free from noxious weeds, mold, and other foreign materials which may affect plant growth. Straw mulch may be from oats, wheat, rye, barley or rice and shall not contain fertile seeds.

B. Mulch shall be furnished in air-dry condition and of proper consistency for placing with commercial blowing equipment or by hand.

PART 3: EXECUTION

3.1 SEED AREA PREPARATION

A. Topsoil Areas

Topsoil shall be replaced with adequate amounts of topsoil material to restore the disturbed area to its original pre-disturbance grade and depth of topsoil but not less than 4 inches.

Prepare subsoil surface for finish grading by dressing and shaping to provide for uniform placement of topsoil. As a minimum the top 1 inch of the subsoil will loosened or scarified before the topsoil is placed.

Remove surface rock or other foreign objects exceeding 1 inch in greatest dimension. Dispose of rock and debris off site in a lawful manner.
Bring the topsoil to the finished grade by raking or with small, light weight machines that do not overly compact the topsoil.

When there is insufficient topsoil available from the site excavated materials, furnish 4 inches of imported topsoil to prepare the seed bed in lawn areas as described in, Part Two, Paragraph 2.01 of this section or clearly marked as lawn areas on the Drawings.

3.2 FERTILIZING

A. Apply fertilizer uniformly to all areas to be seeded. Disk, harrow or rake the fertilizer thoroughly into the soil to a depth of not less than 2 inches. Immediately before sowing the seed, rework the surface until it is a fine, pulverized, smooth seed bed varying not more than 1 inch in 10 feet.

3.3 SEEDING

A. Seed shall be done immediately after preparation and fertilization of the seed bed. Mix the seed thoroughly and sow it evenly over the prepared areas. After sowing, rake or drag the area to cover the seed to a depth of approximately 1/4 inch. Where areas to be restored have slopes greater than 10% sod shall be used.

3.4 SODDING

A. As a minimum, sod shall be fibrous, well rooted approved grass type. The grass shall be cut to a height of less than 3- inches. Edges of sod shall be cleanly cut, either by hand or machine, to a uniform thickness of not less than one and 1-½-inches. Sod shall be free from all primary noxious weeds.

B. Lay sod with tight staggered joints. On slopes, start placement at the foot of the incline. Use wood pegs driven flush to hold sod in place on slopes 4:1 or greater. Roll the sod lightly after placement. Fill any open joints with topsoil and/or sod

C. Around walkways, driveways, grass or other existing borders, remove sufficient soil so that the surface of the sod will be level with the existing surfaces and won’t pose a tripping hazard,

3.5 MULCHING

A. Place mulching material evenly over all seeded areas within 48 hours of seeding if required. Place mulch at the rate of approximately 2 tons per acre, when seeding is performed in recognized growing season and at the approximate rate of 3 tons per acre when seeding is performed in a recognized non-growing season if applicable.
3.6 LANDSCAPED AREAS

Restoration of landscaped areas including plantings, shrubbery, and trees shall be performed in-kind and coordinated with the Project Manager prior to planting.

3.7 MAINTENANCE

A. Carefully maintain, tend, and water all seeded and sodded areas necessary to secure a good, well-established turf. Fill, grade, and reseed or re-sod all areas that have settled. Maintain the condition of the sodded areas for a period sufficient for the grass to root into the topsoil.

END OF SECTION 32 9200
SECTION 33 4100 - STORM UTILITY DRAINAGE 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 gravity-flow, non-pressure storm drainage outside the building, with the following components:
   1. Cleanouts.
   2. Precast concrete manholes.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For manholes and catch basins. Include plans, elevations, sections, details, and manhole frames and covers and catch basin frames and grates.
C. Field quality-control test reports. Product Data: For each type of product indicated.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PE PIPE AND FITTINGS
A. Corrugated High Density Polyethylene (HDPE) Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
B. Corrugated HDPE Pipe and Fittings NPS 12 and Larger: AASHTO M 294M, Type S, with smooth waterway for coupling joints.

C. Pipe shall have integral wall bell and spigot joint with gaskets conforming to ASTM F477. Natural Rubber gaskets will not be accepted.

2.3 REINFORCED CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall "C" or the latest revision thereof.

1. The end joints shall be either bell and spigot or tongue and groove. For all pipe both ends of the pipe shall be concentric with the base of the pipe and they shall be smooth, true and free from spalls and other defects and shall be formed in such a manner to insure accuracy and roundness between pipe and manhole. The connectors clamped to pipes and grouted into manhole walls must be used as rigid connections.

   a. Gaskets: ASTM C 443, rubber

2.4 ALUMINIZED STEEL (CORRUGATED METAL)

A. Type 2 Corrugated Steel Pipe and fittings: AASHTO M 36. US Standard Gage for corrugated steel pipe shall be in accordance with the Standard Detail Drawings. Joints shall be either Hugger-type or Bell and Spigot.

   1. Bell and Spigot Joints. Shall conform to “CONTECH Quick Stab Joint”, or equal 18” through 48” diameter.
   2. Hugger-type Joints. Shall conform to “CONTECH HUGGER Band”, or equal for pipes sizes 15” and larger.

2.5 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

   1. The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D 1784.
   2. Push-on joints shall conform to ASTM D 3212 and gaskets to ASTM F 477. Solvent cements for joining pipe and socket-type fittings shall conform to ASTM D 2564.

B. PVC Sewer Pipe and Fittings, 4 in. and 6 in: ASTM D 2665 (Schedule 40 wall thickness)

C. PVC Sewer Pipe and Fittings, 8” through 15”: ASTM D 3034, SDR 35.

D. PVC Sewer Pipe and Fittings, 18” and Larger: ASTM F 679, PS-46.

2.6 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
1. Available Manufacturers:
   b. MIFAB Manufacturing Inc.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Top-Loading Classification: Heavy duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

1. Available Manufacturers:
   a. Canplas Inc.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

2.7 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 8-inch minimum thickness for floor slab and minimum of one-twelfth (1/12) of the internal shell diameter plus one inch (1") or five inches (5") minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: minimum of one-twelfth (1/12) of the internal shell diameter plus one inch (1") or five inches (5") minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
7. All interior surfaces of precast concrete manholes shall receive a troweled or broomed grout finish to fill air holes and irregularities prior to applying the epoxy coatings. The interior surfaces shall be coated with two coats of Tnemec Series 66 Hi-Build epoxy or other approved equal. When the paint coating is applied by the manufacturer, surfaces which are to be grouted or patched shall not be painted until after assembly of the manhole. The contractor shall apply epoxy to touch up damaged surfaces and cover patches or grouted areas. Each application of epoxy coating shall have a minimum dry film thickness of 4 mils.
8. All grout used to close openings around waterstop gaskets and sewer pipes shall contain approved non-metallic shrinkage correcting aggregate.
9. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   a. Cast-In Resilient Connectors Type cast into manhole wall at the manufacturing facility. The connection is completed by inserting end of pipe through connector. Connector shall be A-Lok or approved equal.
   b. For connection to an existing structure only: Type clamped around end of pipe and grouted into opening in manhole wall. Connector shall be G3 Boot System featuring component packaging as manufactured by A-LOK Products, Inc. or approved equal. Non-shrink grout must be used.

10. Steps: Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
   b. Copolymer Polypropylene Plastic Step, PS1-PF or PS2-PF Manufactured by M.A. Ind., Inc. or approved equal.

11. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.

12. Grade Rings: Reinforced-concrete rings, 3- to 6-inch total thickness, to match diameter of manhole frame and cover.

B. Manhole Frames and Covers: ASTM A 48, Class 35B or higher, except as modified or supplemented herein, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover. Include indented top design with lettering "SANITARY SEWER" cast into cover. All frames shall be bolted to the concrete manhole wall. All covers shall be bolted to the manhole frame.
   1. Manhole frames and covers shall be manufactured so as to be fully interchangeable. All of the covers provided shall be suitable for installation on any of the frames provided and shall not rock or tip under an applied load.
   2. All castings imported into the United States shall conform to the applicable provisions of the United States Customs regulations.
   3. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
   4. Rings and bolt-down covers shall be proved with machined surfaces, O-ring gaskets and five-eighths (5/8) inch pent-head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

2.8 STORMWATER INLETS

A. Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
B. Frames and Grates: ASTM A 36, Grade 60-40-18, Steel.
   1. Bolt-down type manhole rings shall be anchored to the manhole walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of fourteen (14) inches, except where the entire ring is embedded in a concrete top slab.
   2. (4) Rings and bolt-down covers shall be proved with machined surfaces, O-ring gaskets and five-eighths (5/9) inch hex head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The O-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

2.9 CONCRETE

A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
   1. Include channels and benches in manholes.
      a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to one-half of pipe diameter. Form curved channels with smooth, uniform radius and slope.
         1) Invert Slope: 2 percent through manhole (min.) or as indicated on drawings.
      b. Benches: Concrete, sloped to drain into channel.
         1) Slope: 4 percent.
   2. Include channels in storm sewer inlets.
      a. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
         1) Invert Slope: 2 percent through inlet (min.) or as indicated on drawings.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 minimum, with 0.58 maximum water-cementitious ratio.

E. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
2.10 ENGINEERED PVC SURFACE DRAINAGE PRODUCTS

A. General: PVC surface drainage inlets shall include the drain basin type as indicated on the contract drawings and referenced within these specifications. The cast iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The surface drainage inlets shall be as manufactured by Nyloplast, a division of Advanced Drainage Systems, Inc. or prior approved equal.

B. Materials

1. The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the main body of the drain basin. The pipe stock used to manufacture the main body and pipe stubs of the surface drainage inlets shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.

2. The grates furnished for all surface drainage inlets shall be ductile iron grates for sizes 8”, 10”, 12”, 15”, 18”, 24” and 30” (12” and 15” frames are cast iron) shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for drain basins shall be capable of supporting H-25 wheel loading for heavy-duty traffic or H-10 loading for pedestrian traffic. 12” and 15” grates will be hinged to the frame using pins. Metal used in the manufacturing of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron and ASTM A-48-83 class 30B for 12” and 15” cast iron frames. Grates shall be provided painted black.

C. Installation

1. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed limestone or other granular material meeting the requirements of class 1 or 2 material as defined in ASTM D2321. The surface drainage inlets shall be bedded and backfilled uniformly in accordance with ASTM D2321. The drain basin body will be cut at the time of the final grade so as to maintain a one piece, leak proof structure. No brick, stone or concrete block will be used to set the grate to the final grade height. For H-25 Load rated installations, an 8” to 10” thick concrete ring will be poured under the grate and frame as recommended by details provided by the manufacturer.

2.11 PIPE OUTLET

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. End Sections: Unless shown otherwise, provide standard end sections follows:

1. Standard Precast Concrete for pipe size indicated.
2. Standard Corrugated Steel End Section with protective coating for pipe size indicated.
3. Provide Riprap at each end section in accordance to plans.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section “Trenching, Backfill and Compaction.”

1. Backfilling Prior to Approvals: Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests and approvals. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.

B. General: This section covers excavation, trenching, backfilling and grading incidental to the construction of sewers, pipelines and structures shown on the Drawings and described in these Specifications. Unless specifically shown or designated otherwise, all excavation shall be by open cut. The Contractor shall assume full responsibility for satisfactory performance of the work and for the safety of the work, working personnel and the general public.

1. Excavation

   a. Structure Excavation: Excavation for structures shall be to lines and grades shown on the Drawings. Extend excavation for formed structures sufficiently to permit construction and inspection of forms, and for installation of drain tile or other below-grade work. The excavation shall be maintained in a condition suitable for placing reinforcing steel and concrete by such dewatering of adjacent and underlying soil as may be required. Dewatering equipment and methods shall be approved by the Engineer. Approved dewatering equipment may be used within the structure provided that any openings in walls or floors shall subsequently be closed watertight, using methods and procedures approved in advance by the Engineer. Excavation shall be shored and braced to protect adjacent structures or installations from damage. Before placing any concrete, excavation shall be inspected and approved by the Engineer.

   b. Structure Subgrade: A normal foundation under structures will be undisturbed soil. If over excavation occurs or is required, the subgrade may be brought back to grade using approved material from excavation or borrow sources, uniformly compacted as specified for “Type A” compaction. Unless over-excavation of structure subgrade is authorized by Engineer, the corrective action shall be at Contractor expense. Alternatives to the above corrective method are:

      1) Using the bedding material specified in Paragraph h.
      2) Increasing the thickness of the concrete base.

   c. Trench Excavation: Trench excavation shall be to the lines and grades indicated on the drawings. Banks shall be vertical from bottom of the trench to at least 6 inches above the top of the pipe. Above that point, trench wall may be sloped as required for safety and shall conform to all pertinent OSHA Regulations. Trenches shall be excavated as near as is practical to the widths shown on the applicable Standard Sewer Detail sheet of the Drawings. The bottom of the trench shall be undisturbed soil smoothed to the satisfaction of the Engineer by backhoe bucket or hand shovel, or both, prior to placement of bedding material. Dewatering, when required, shall be subsidiary to other bid items.
d. Rock Excavation: Trench width used in computing rock excavation shall be the width shown on the applicable Standard Sewer Detail sheet of the Drawings. Rock excavation shall include the excavation of all sedimentary, igneous and metamorphic rock which is naturally in place and is firm, rigid and unweathered and all boulders or other detached stone with a volume of 2 cubic yards or more. Rock encountered in two or more ledges with interlaying strata of soil, clay, gravel or shale not more than 12 inches in thickness between each ledge will be classified as solid rock from the top of the top ledge to the bottom of the bottom ledge of rock. Rock shall be excavated to a depth of not less than 4 inches below the bottom of structures or of sewer pipe and 12 inches below the bottom of finished subgrade for pavement construction.

e. Sheeting and Bracing: Sheeting and bracing shall be provided in all trenches where required and shall conform to all pertinent OSHA Regulations. Sheeting may be wood or metal. Wherever, because of unstable trench conditions, it is necessary to drive sheeting below the centerline of pipe, it shall be driven to a depth of 2 feet (minimum) below the flowline of the pipe. After the trench has been backfilled up to a level 1 foot above the pipe, sheeting may be removed and the space left because of such removal shall be filled immediately and the backfill re-compacted. Wood sheeting which has been driven to below the centerline of the pipe shall be left in place below a level of 1 foot above the top of the pipe. Trench boxes or shields may be used instead of sheeting and bracing.

f. Control of Ground Water and Surface Water: Where ground water or surface water is encountered, trenches shall be dewatered as necessary to permit the construction to be carried on in a satisfactory manner. Portions of sewers where all joints have been completed may be used for draining trenches, provided such drainage is free from debris. Drainage may be collected in temporary sumps and then pumped into natural drainage channels as approved by the Engineer. Surface water shall be prevented from entering trenches. Where approved by the Engineer, and approved in writing by the property owner, existing drainage channels may be temporarily diverted. After completion of the construction, the temporary channels and original channels shall be returned to their original condition unless otherwise approved by the property owner. It shall be the contractor’s responsibility to obtain the permission of the property owner, in writing, for the temporary channels.

g. Stabilizing Trench Bottoms and Structure Subgrade: Wet or unstable trench bottoms and structure subgrade shall be stabilized by excavating to additional depth as directed by the Engineer and replacing the unsatisfactory soil with crushed limestone with angular shapes for high interlocking capability graded as follows. Field conditions shall be the determining factor for individual or combined use of these materials. The upper 2 inches of any stabilized area shall consist of specification bedding material. In sewer trenches, the minimum depth of bedding material shall be 4 inches under the pipe.

1) 4 inch to 8 inch primary crusher run.
2) 3 inch to 4 inch crusher run.
3) 1 ½ inch poorly graded.
4) ¾ inch poorly graded.
5) Specification bedding material.

h. Bedding Material and Placement: Bedding material shall be placed and compacted as specified for "Type A" compaction. Trenches shall be excavated to a depth not less than 4 inches below the bottom of the pipe and the pipe shall be laid
on a bed of crushed limestone having the following characteristics unless otherwise shown on the plans:

1) Retained on ¾ inch sieve: 0%.
2) Retained on ½ inch sieve: 24% to 35%.
3) Retained on 3/8 inch sieve: 40% to 60%.
4) Retained on No. 4 sieve: 90% to 100%.
5) Deleterious Substances, maximum: 5%.

2. Backfill

a. General: Prior to the placement of either structure backfill or trench backfill, a Standard Proctor Curve as determined by AASHTO T 99 (ASTM D 698) shall be obtained for each type of backfill material to be used. Proctor curves shall be obtained from soil samples selected by a certified testing laboratory from materials excavated by the Contractor. All costs associated with the selection of soil samples and performing the necessary tests to obtain the Proctor curves shall be paid by the Contractor. Selection of the correct Proctor curve for a particular backfill material shall also be done by the Contractor’s certified testing laboratory. During backfill operations, soil density tests shall be taken by the Engineer or his representative. When results indicate that compaction does not meet the requirements of these Specifications, the material shall be removed and replaced or re-compacted as necessary to meet the specified requirements at no additional expense to the Owner. Additional tests shall be performed on re-compacted area to insure compliance with the requirements.

b. Recommendations for Compaction Equipment: Most manufacturers of compaction equipment provide information for the use of their equipment. For compaction of cohesive soils such as clay or clay-silt mixes, the recommended equipment includes rammers which shear and knead the soil and sheepfoot rollers, either towed or backhoe mounted static types or self-propelled static or vibratory, which shear, blend and bond the soil. These recommendations also indicate that the thickness of the soil layer being compacted should not exceed the capabilities of the compacting force of the equipment being used. Proper thickness allows full and uniform densification of each layer and is directly proportional to the number of passes required to achieve the desired result. Steel wheeled smooth rollers, either static or vibratory or vibratory smooth plates are not normally recommended for use on cohesive soils but are highly recommended for consolidating granular soils. When compacting a mixture of cohesive and granular soils, equipment designed for the predominant soil type should be used.

c. Basis for Acceptance of Compaction: Normally the nuclear densimeter test shall be the basis for acceptance of compacted backfill. However, when backfill materials consist of a mixture of different soil types or contain a substantial amount of rock chips, the nuclear densimeter may give erroneous results. Therefore, the test results may be tempered by the judgment of the Engineer’s representative after observing the compaction effort. The decision to accept or reject compacted backfill may be influenced by the thickness of lift, type of compaction equipment, number of passes of compaction equipment, depth of penetration of steel probe into the compacted material or successful proof rolling with a fully loaded tandem axle dump truck.

d. Backfill Around Structures: Backfill around structures with approved material after completion of below grade construction and removal and cleanup of all forms, lumber and trash. Each layer shall be placed and compacted as specified for Type A compaction and shall include emphasis on the area adjacent to the structure walls.
e. Trench Backfill: Backfill trenches only after pipelines, joints, wyes and bedding have been inspected and approved. Backfill with approved material from excavation or supplementary borrow areas, free from rocks or clods larger than 3 inches in any dimension.

1) Initial Backfill for Pipes with Pipe Stiffness (PS) of 100 or less. This category includes PVC pipe meeting the requirements of ASTM D 3034 SDR 35 and ASTM F 679 PS 46. Initial backfill shall consist of specified bedding material to a point 6 inches above the top of the pipe. Care shall be taken to insure that bedding material is worked in around the haunches of the pipe. Bedding material shall be compacted as specified for Type A compaction.

2) Initial Backfill for Pipes with Pipe Stiffness (PS) over 100. This category includes PVC pipe meeting the requirements of ASTM D 2665 (Schedule 40), ductile iron pipe, vitrified clay pipe, reinforced concrete pipe and corrugated steel pipe. For pipe up to and including 12 inches in diameter, the initial backfill shall consist of specified bedding material to the top of the pipe. For pipe over 12 inches in diameter, initial backfill shall consist of specified bedding material to the springline of the pipe. Care shall be taken to insure that bedding material is worked in around the haunches of the pipe. Bedding material shall be compacted as specified for Type A compaction.

3) Backfill from Springline to One Foot Over Top of Pipe: This applies to all types of pipe regardless of where the top of bedding material is located. Selected backfill material shall be placed on both sides of the pipe equally to the full width of the trench in loose layers not to exceed 6 inches thick. Each layer shall be compacted as specified for Type A compaction. Continue to place and compact subsequent layers until the pipe is covered to a depth of at least one foot. All material to this depth shall be compacted as specified for Type A compaction.

4) Backfill for the Remainder of the Trench: After selected backfill and compaction to 1 foot above the top of pipe, the remaining backfill shall be composed of selected excavated materials free from large clods, rocks, frozen materials, debris or junk or of approved supplementary borrow material. Backfill material shall be deposited and compacted as detailed for the required type of compaction.

3. Compaction

a. Type A Compaction: Type A compaction shall be used under all paved areas proposed or future paved areas, except sidewalks and under utility tunnel crossings. Type A compaction shall also be used where sewers intersect stream beds and at other locations designated on the Project Drawings, around structures, and to a level not less than 1 foot above the top of sewer pipes, as specified elsewhere in this section. Backfill shall be composed of selected excavated material or approved supplementary borrow material. Backfill material shall be deposited in loose layers not more than 6 inches thick, and compacted to at least 95 percent of maximum density in accordance with AASHTO T 99 (Standard Proctor).

b. Type B Compaction: In areas where Type A compaction is not specified, approved backfill material shall be placed in the trench in loose layers not more than 10 inches thick and compacted to a density equal to or greater than that of the material in the adjacent trench wall.
4. Unsuitable Backfill Material: No material shall be used for structure backfill or trench backfill which contains rocks or clods larger than 3 inches in any dimension, frozen material, debris, junk or organic material. Such material shall be removed from the backfill material and disposed of as directed by the Engineer. Removal and disposal of unsuitable material is subsidiary to other bid items.

5. Supplementary Borrow Material: Furnished by Contractor at his expense.


7. Clean-Up: Clean-up is considered an integral part of the work. The working area shall be promptly restored to a condition equal to or better than that prevailing before construction. The Engineer may, at his discretion, withhold payment for otherwise completed items of work in areas in which clean-up is not completed, unless the Contractor submits, in writing, acceptable reasons why clean-up is incomplete, and provides an acceptable schedule for completion.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer’s written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

F. Familiarization: Prior to all work of this section, become thoroughly familiar with the site, the site conditions and all portions of the work falling within this section. No extra will be allowed for rock excavation.

G. Install gravity-flow piping and connect to building’s storm drains, of sizes and in locations indicated. Terminate piping as indicated.

1. Install piping pitched down in direction of flow, as indicated on the plans.

H. Removal of Water

1. Furnish and operate sufficient pumps and appliances and provide all materials, labor, etc., required to prevent interference with any work by water, ice or snow. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper conduct of the work shall be made good by the Contractor at his own expense.

2. No structure or pipe shall be laid in water and no water shall be allowed to run into or over any concrete work or pipe, or into or through any pipe, unless by special permission in writing.

I. Pipe Handling & Cutting
1. Care shall be used in handling all pipe to prevent damage to pipe ends. Particular care shall be taken not to injure any pipe coatings. No other pipe or material of any kind shall be placed inside of any pipe or fitting, except as specifically indicated.
   a. Damaged pipe or pipe damaged in laying shall be replaced at the expense of the Contractor.
   b. Cutting shall be done in neat and workmanlike manner by a method which will not damage the pipe. All cutting shall be done by means of a mechanical cutter.

J. Provide the necessary mason's lines and supports or laser equipment to insure installation of the pipe to line and grade, as shown on the drawings. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

K. The Engineer may, at his option, inspect all pipe before it is laid and reject any section that is damaged by handling or is found to be defective to a degree which will materially affect the function and service of the pipe.

L. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bell shall be laid upgrade, with the spigots that fit within the bells laid in the direction of flow. If tongue and groove pipe is used, the groove shall be laid upgrade, with the tongue that fits inside the groove laid in the direction of flow. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

M. The pipe shall be firmly and accurately set to the line and grade so that the invert will be smooth and uniform in slope.

N. Granular Bedding: Pipe shall be laid in compacted granular bedding as shown and as indicated in the plans or specified herein.
   1. Granular Bedding: Clean, well-graded crushed stone, chat, sand or gravel. Maximum particle size of one inch (1") diameter.
   2. Granular bedding shall be placed and compacted simultaneously on each side of pipe using particular care to obtain uniform bedding throughout the length of pipe without causing displacement of or damage to joints.
   3. When bell and spigot pipes are used, spaces for the pipe bells shall be dug in the pipe bedding to accommodate the bells. These spaces shall be deep enough to insure that the bells do not bear the load of the pipe; they shall not be excessively wide in relation to longitudinal direction of the trench. When the pipes are laid, the barrel of each section of pipe shall be in contact with the bedding throughout its full length, exclusive of the bell, to support the entire load of the pipe.
   4. Pipe shall not be laid on frozen ground under embedment.

O. Pipe which is not true in alignment or which has shown any settlement after laying shall be taken up and re-laid without extra compensation

3.3 PIPE JOINT CONSTRUCTION

A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, non-pressure drainage piping according to the following:
1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
2. Join dissimilar pipe materials with non-pressure-type flexible couplings.

C. PVC Sewer Pipe and Fittings: As follows:
1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Install according to ASTM D 2321.

D. Concrete Pipe and Fittings: Install according to ACPA’s "Concrete Pipe Installation Manual."
Use the following seals:
2. All joints shall be sealed with an approved plastic compound. In sealing pipe joints with plastic joint compound, trowel grade compound shall be applied to the mating surfaces of both the tongue and groove, or to the entire interior surface of the bell and the upper portion of the spigot. Rope or tape type and trowel grade plastic compound shall be applied in accordance with the manufacturer's recommendations. The joints shall be forced together with excess compound extruding both inside and outside the joint. Excess compound shall be removed from the interior surface where accessible.

E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

G. Connection to Existing Drainage Structures
1. Where the drawings call for connections to existing or extension of structures, these connections shall be watertight and so made that a smooth uniform flowline will be obtained throughout the drainage system. Method to be approved.

3.4 CLEANOUT INSTALLATION
A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use extra-heavy-duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 24 by 24 by 7-1/2 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION
A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inch above finished surface elsewhere, unless otherwise indicated.

3.6 STORM DRAINAGE INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipators at outlets, as indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.8 INLET INSTALLATION

A. Set frames and grates to elevations indicated.

3.9 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's storm building drains specified in Division 33 Section "Storm Utility Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

E. Regulatory Requirements: Comply with requirements of applicable codes, regulations and authorities having jurisdiction.

F. Maintenance

1. If at any time before 12 months after the completion and acceptance of the work, there shall be any settlement of trenches requiring repairs to be made in any roadway, parking area or property along the line of the work, or should any defect appear in the work due to neglect, carelessness or improper construction on the part of the Contractor, the Engineer will notify the Contractor to make such repairs and remedy any defects. The Contractor shall, within 5 days after such notice, begin and carry out such repairs at no additional cost to the Owner.

END OF SECTION 33 4100
DIVISION 22
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PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Plumbing Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK
A. This DIVISION requires the furnishing and installing of complete functioning Plumbing systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system’s functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
B. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS
A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.
B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.
D. “PROVIDE” means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
E. “INSTALL” means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
F. “FURNISH” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
G. “WIRING” means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
H. “CONDUIT” means the inclusion of all fittings, hangers, supports, sleeves, etc.
I. “AS DIRECTED” means as directed by the Architect/Engineer, or his representative.
J. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS
A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS
A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES
A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.
1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, piping and other plumbing work are indicated diagrammatically by the plumbing drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.

B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.

C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.

D. Do not scale mechanical, plumbing and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicated on the Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of plumbing systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor’s expense.

B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner’s best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer’s brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer’s name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused atEngineer’s option. Equivalents will ONLY be considered...
approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in plumbing or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer’s descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer’s certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.15. EXTENT OF CONTRACT WORK

A. Provide plumbing systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of plumbing systems. In no case will claims for “Extra Work” be allowed for work about which Contractor could have been informed before bids were taken.

B. Contractor shall become familiar with equipment provided by other contractors that require plumbing connections and controls.

C. Electrical work required to install and control plumbing equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor’s base bid proposal.

D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.

E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Plumbing Contractor at no cost to Owner or Architect-Engineer.

F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of plumbing and electrical equipment are made to attain intended control sequences and system operation.

G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.

H. Contractor shall obtain complete electrical data on plumbing shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of plumbing equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

1.16. WORK NOT INCLUDED IN CONTRACT

A. Consult Division 21, 23, and 26 of specifications for work to be provided by Electrical Contractor in conjunction
1.17. **CODES, RULES AND REGULATIONS**
A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.18. **SAFETY CODES:**
B. Occupational Safety and Health Standard (OSHA) - Department of Labor.

1.19. **NATIONAL FIRE CODES:**
A. NFPA No. 54  Gas Appliance & Gas Piping Installation
B. NFPA No. 70  National Electrical Code
C. NFPA No. 89M  Clearances, Heat Producing Appliances

1.20. **UNDERWRITERS LABORATORIES INC:**
A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.21. **MISCELLANEOUS CODES:**
A. ANSI A117.1 - Handicapped Accessibility
B. Applicable State Boiler Codes
C. Americans with Disabilities Act (ADA)

1.22. **ENERGY EFFICIENCY REQUIREMENTS:**
A. All plumbing systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

1.23. **STANDARDS**
A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.24. **PERMITS/FEES**
A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

2.1. Not Used

PART 3 - EXECUTION

3.1. **SHOP DRAWINGS**
A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.
B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each
catalog sheet shall bear the equipment manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor's approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor's stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Plumbing shop drawings for pipe fabrication shall be a minimum of 1/4" scale. Provide drawings where the complexity of the system or confines of the space require coordination with construction and other trades. Plumbing shop drawings shall not be a reproduction of the contract document and shall show details of the following: Plans, elevations above finished floor, sections, components, insulation and attachments to other work. Plumbing layout indicating sizes on plans, fittings, insulation, clearances, penetrations through fire-rated partitions, and attachment methods for building attachment, vibration, isolation, seismic restraints, and attachment.

L. Architect-Engineer's review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

A. Contractor shall provide the following submittal sections that apply to this project:

1. SECTION 220520 - BASIC PLUMBING MATERIALS AND METHODS:
   a. Test methods and pressures
   b. Sterilization of domestic water systems
   c. Piping, and fittings
2. SECTION 220523 – VALVES
3. SECTION 220530 - MOTOR CONTROL AND EQUIPMENT DISCONNECTS
   a. Disconnect Switches
   b. Motor Starters
4. SECTION 220548 – PLUMBING VIBRATION CONTROL:
   a. Vibration isolation
   b. Isolation of piping systems
   c. Isolation of fractional horsepower equipment
5. SECTION 220560 - VARIABLE FREQUENCY CONTROLLERS
   a. Drives and Accessories
6. SECTION 220700 – PLUMBING INSULATION:
   a. Piping and equipment insulation
7. SECTION 221116 – PLUMBING PIPING:
   a. Piping materials
   b. Supports, anchors
   c. Sleeves and seals
8. SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES:
   a. Temperature mixing valves
   b. Hose bibbs / wall hydrants
   c. Backflow preventers
   d. Domestic hot water expansion tanks
   e. Water hammer arresters
   f. Recirculation pumps
   g. Thermometers and gauges
9. SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES:
   a. Cleanouts
   b. Floor drains
   c. Roof drains / downspout nozzles
   d. Interceptors
10. SECTION 223100 – DOMESTIC WATER SOFTENERS
11. SECTION 223300 – WATER HEATERS
12. SECTION 224000 – PLUMBING FIXTURES

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)
   A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
   B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
   C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:
      1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
      2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
      3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
      4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of plumbing system.
   D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
1. Project name and address.
2. Section of work covered by brochure, i.e., “Plumbing”, etc.

3.5. RECORD DOCUMENTS
A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
C. Provide one copy of on high quality heavy weight presentation type paper. Media which fade shall not be used.
D. Provide one electronic version of record documents in Adobe PDF format on a DVD or otherwise electronically transmitted. Transmit electronic copies in conjunction with hard copy documents.

3.6. CLEANING UP
A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
B. Contractor shall clean up all ductwork and equipment at the completion of the project.
C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.7. WATERPROOFING
A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.8. CUTTING AND PATCHING
A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of plumbing work shall be repaired at Contractor's expense to approval of Architect-Engineer.

3.9. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS
A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Plumbing contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to
Architect-Engineer for review before proceeding with fabrication or installation.

3.10. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner’s operating personnel shall be present during these operations.

B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.

C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the “training” session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.11. FINAL CONSTRUCTION REVIEW

A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 220500
SECTION 220505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.
   4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate required installation sequences.
   c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

   2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.

   3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

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PROJECT COORDINATION
1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.

B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.

C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.

D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.

E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.

F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.

G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.

H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

1. Right-of-Way:
   a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
   b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.

J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.

K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.

L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Organize meeting with agenda and invite all pertinent attendees. Notify Architect and owner of relevant meetings. Record all decisions made and distribute minutes within 3 days of meeting.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

   2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
      b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Possible conflicts.
i. Compatibility problems.
j. Time schedules.
k. Manufacturer’s written recommendations.
l. Warranty requirements.
m. Compatibility of materials.
n. Space and access limitations.
o. Regulations of authorities having jurisdiction.
p. Testing and inspecting requirements.
q. Installation procedures.
r. Coordination with other work.
s. Required performance results.
t. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Notify Architect of meeting.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress.

a. Combined Contractor’s Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.

b. Review present and future needs of each contractor present, including the following:

i. Interface requirements.
ii. Sequence of operations.
iii. Status of submittals.
iv. Deliveries.
v. Off-site fabrication.
vi. Access.
vii. Quality and work standards.
viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor’s suggested solution(s) to RFI. If Contractor’s solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings,
and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 220505
SECTION 220520 – BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1. TESTING PROCEDURES FOR PIPING SYSTEMS
A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
F. For test pressure schedules see Section 221100 of this specification.

3.2. TEST METHODS AND PRESSURES
A. Test methods and pressures shall be as follows:
   1. Hydrostatic Test (Closed Systems):
      a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.
   2. Pneumatic Test:
      a. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
      b. Allow at least 1 hour after test pressure has been applied before making initial test.
      c. Curing test, completely isolate entire system from compressor or other sources of air pressure.
   3. Pressure Relief and Safety Valve:
      a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
      b. Tag items that pass test with date of test, observed relief pressure setting and inspector’s signature.
      c. Items installed in systems without test tag attached will be rejected.

3.3. STERILIZATION OF DOMESTIC WATER SYSTEMS
A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
D. Test samples taken from several points in system shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.
3.4. CLEANING OF SYSTEMS AND EQUIPMENT
   A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

3.5. MAINTENANCE OF SYSTEMS
   A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
   B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
   C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determined by Equipment Manufacturer’s recommendations.

3.6. PAINTING OF MATERIALS AND EQUIPMENT
   A. Paint all exterior piping with (2) two coats of an enamel rust-inhibiting exterior paint in a color selected by architect.
   B. Touch-up painting and refinishing of factory applied finishes shall be by Plumbing Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
   C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
   D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
   E. Where extensive refinishing is required equipment shall be completely repainted.

3.7. PIPING IDENTIFICATION
   A. Provide pipe markers at 10'-0" maximum spacing to identify piping in mechanical rooms and 20'-0" maximum spacing in all other areas with Seaton Setmark pipe markers with letters and flow direction arrows.
   B. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers.
   C. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements.

3.8. VALVE IDENTIFICATION
   A. Mark all valves with Seton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black ½” high. Tags shall be minimum 2” in diameter and attached to valve with Seton No. 16 brass jack chain.
   B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

3.9. EQUIPMENT LABELS:
   A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Black letters on white background.
   B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   C. 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.
   D. Fasteners: Stainless-steel rivets or self-tapping screws.
   E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
   F. 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.

3.10. EXCAVATION AND BACKFILL
   A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
   B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
   C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or
adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.

D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.

E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

3.11. EQUIPMENT ANCHORS

A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.

B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.

C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

3.12. WELDING

A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.

B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.

C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders’ code, date and types of latest qualification test passed by each welder.

D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 “Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing”. Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 220520
SECTION 220523 – VALVES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. EQUIVALENCES
A. Equivalent valves shall be used only from the following specified valve manufacturers and listed on current comparison charts by Apollo, Hammond, Hays, Milwaukee, Muessco, Nibco, Rockwell-Nordstrom, Stockham, and Watts.

1.3. SUBMITTALS
A. Product Data: For each type of valve indicated.

1.4. QUALITY ASSURANCE
A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1. GENERAL REQUIREMENTS FOR VALVES
A. Plumbing valve applications specified in this Section are limited to NPS 12 (DN 300).
B. Refer to valve schedule articles for applications of valves.
C. Caution: Revise pressure ratings and insert temperature ratings in valve articles if valves with higher ratings are required.
D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
E. Valve Sizes: Same as upstream piping unless otherwise indicated.
F. 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 except plug valves.
   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.
G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
H. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.

2.2. VALVES
A. BALL VALVES
   1. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:
   2. Provide ball handle with extension or offset as required to clear piping insulation.
      a. BLV-1: 2-1/2" valves and smaller, Hammond #8501 (screwed) or 8511 (solder) series bronze two piece large port ball valve 600 PSI-WOG/150 PSI-WSP reinforced TFE seats, chrome plate brass ball (tunnel or drilled design), silicon bronze stem vinyl-covered steel lever handle. Stainless steel ball and stem shall be provided for steam applications.
b. BLV-2: Ball valve shall be flexible lip seat to assure positive shut off (in both directions) and self compensates for wear. Material - fiberglass reinforced teflon, single piece. Self-adjusting, low friction teflon box ring stem seals pre-loaded by Belleville washers. Two-piece carbon steel body. Four bolt design with locking fasteners for vibration resistance and joint integrity, one piece teflon body seal. Valve shall be rated for 250 PSI steam service. 316 stainless steel ball and stem. Provide with insulated handle. Neles Jamesbury Model 21-2236MT. Equivalent by Worchester. MCF Series 56-HT.

B. GLOBE VALVES

1. Globe valves shall be scheduled as type “GLV” valves. Valve specifications by type number shall be as follows:
   a. GLV-1: 2-1/2” valves and smaller, Hammond #IB413T (screwed) or IB423 (solder) bronze globe valve, 300 PSI-WOG/150 PSI-WSP union bonnet, Teflon disc, malleable iron handwheel.

C. PLUG VALVES

1. Plug valves shall be scheduled as type “PLV” valves. Valve specifications by type number shall be as follows:
   a. PLV-1: 1” valves and smaller Hays 7400 series iron body gas cock, 175 PSI-WOG bronze plug washer and nut, screwed ends.
   b. PLV-2: 1-1/4” through 4” valves, Rockwell-Nordstrom Fig. 142, semi-steel lubricated plug valve, 175 PSI-WOG coated plug, two bolt cover, and short pattern screwed ends. Provide complete with standard pattern cast handle.

D. CHECK VALVES

1. Check valves shall be scheduled as type “SCV” valves. Valve specifications by type number shall be as follows:
   a. SCV-1: 2” valves and smaller Hammond #IB940 (screwed) or IB912 (solder) bronze check valve, 200 PSI-WOG/125 PSI-WSP, Teflon or bronze disc and seat ring.
   b. SCV-2: 2-1/2” and larger Hammond #IR1124 HI flanged, ASTM 126 iron body, bronze trimmed, 200 PSI-WOG/125 PSI-WSP.

E. MANUAL BALANCING VALVES

1. Balancing valves shall be scheduled as Type “BAV” valves. Contractor shall provide bronze balancing valves with provisions for connecting differential pressure meter for purposes of setting flow rate through valve. Contractor shall install balancing valves in a manner that allows access to the setting indicator and the gauge connections. Valves shall be shipped in polyurethane block to be used as insulation. Equivalent valves by Armstrong, Bell and Gossett, Tour and Anderson, Nibco. Valves shall be as follows:
   a. BAV-1 Sizes ½” through 6” Armstrong Model CBV I or CBV II circuit balance valve, 125 PSI-WP at 250 degrees F., meter connections with built-in check valves screwed or flanged ends. Provide complete with polyurethane insulation cover.

2.3. VALVE SCHEDULE

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>SIZE</th>
<th>STOP</th>
<th>CHECK</th>
<th>BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Water</td>
<td>½”-2 1/2”</td>
<td>BLV-1</td>
<td>SCV-1</td>
<td>BAV-1</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>½” - 1”</td>
<td>PLV-1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1-1/4”-4”</td>
<td>PLV-2</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

PART 3 – EXECUTION

3.1. VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2. INSTALLATION

A. Install necessary valves within piping systems to provide required flow control, to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
B. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance and wherever possible, gate, check and ball valves shall be installed on a horizontal run with the handle upright and within 15 degrees of vertical. Butterfly valves shall be installed with the stem in the horizontal position and the handle at 90 degrees from vertical.
C. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
D. Valves 2-1/2" and smaller shall have soldered or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections.
E. Valves shall be designed for repacking under pressure when fully opened and backseated.
F. Balancing valves installed by means of sweating or soldering shall have their interiors removed before installation and reinstalled upon dissipation of the heat associated with installation. Using a wet rag in lieu of removing the valve interior as a means of heat dissipation during installation is not acceptable.

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.

END OF SECTION 220523
SECTION 220700 – PLUMBING INSULATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Cellular glass.
      b. Flexible elastomeric.
      c. Mineral fiber.
      d. Polyolefin.
   2. Insulating cements.
   3. Adhesives.
   5. Sealants.
   6. Factory-applied jackets.
   7. Field-applied jackets.
   8. Tapes.

B. SUBMITTALS

   1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
   2. Shop Drawings:
      a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
      b. Detail attachment and covering of heat tracing inside insulation.
      c. Detail insulation application at pipe expansion joints for each type of insulation.
      d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
      e. Detail removable insulation at piping specialties, equipment connections, and access panels.
      f. Detail application of field-applied jackets.
      g. Detail application at linkages of control devices.
      h. Detail field application for each equipment type.
   3. Qualification Data: For qualified Installer.
   4. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. QUALITY ASSURANCE

   1. 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.
   2. 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, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
      a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
      b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
1.3. DELIVERY, STORAGE, AND HANDLING
   A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.4. COORDINATION
   A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment.”
   B. Coordinate clearance requirements with piping Installer for piping insulation application 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.
   C. Coordinate installation and testing of heat tracing.

1.5. SCHEDULING
   A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
   B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1. INSULATION MATERIALS
   A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
   B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
   C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
   D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2. PIPING AND EQUIPMENT INSULATION
   A. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
      1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         a. Cell-U-Foam Corporation; Ultra-CUF.
         b. 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. If retaining both types of insulation in first two subparagraphs below, indicate where each type applies in insulation system schedules.
      6. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
      8. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
   B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
      1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         a. Aeroflex USA Inc.; Aerocel.
         b. Armacell LLC; AP Armaflex.
         c. RBX Corporation; Insul-Sheet 1800 and Insul- Tube 180.
   C. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
      1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         a. CertainTeed Corp.; Duct Wrap.
D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000(Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.

2.3. INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4. ADHESIVES

A. Military Specification referenced in this article is the only standard available when this Section was updated. MIL-A-3316C was last updated in October 1987.

B. 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.

1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).


1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5. MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
2.6. SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7. FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. 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.
   4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

2.8. FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

2.9. FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Although other thicknesses for PVC jackets are available, a flame-spread index of 25 and a smoke-developed index of 50 apply only to thicknesses of 30 mils (0.8 mm) and less.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
   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.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
   1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
   2. Factory cut and rolled to size.
   3. Finish and thickness are indicated in field-applied jacket schedules.
   4. Among the three moisture barriers in first subparagraph below, 1-mil (0.025-mm) barrier provides the least protection against galvanic corrosion, 3-mil (0.075-mm) barrier offers better protection, and Polysurlyn barrier offers the best protection. For most indoor applications, 1-mil (0.025-mm) barrier is adequate. For outdoor applications, select either 3-mil (0.075-mm) or Polysurlyn barrier.
   5. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   6. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
   7. Factory-Fabricated Fitting Covers:
      a. Same material, finish, and thickness as jacket.
      b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      c. Tee covers.
      d. Flange and union covers.
      e. End caps.
      f. Beveled collars.
      g. Valve covers.
      h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10. TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.
D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.
E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches.
2. Film Thickness: 6 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

2.11. SECUREMENTS
A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

2.12. INSULATION SCHEDULE
A. See plans for piping and insulation schedule. Other insulation requirements are scheduled below:

<table>
<thead>
<tr>
<th>INSULATION SERVICE</th>
<th>SIZE</th>
<th>TYPE</th>
<th>THICKNESS</th>
<th>JACKET</th>
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<tr>
<td>Drinking Fount. Drain</td>
<td>All Sizes</td>
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<td>1”</td>
<td>ASJ-SSL</td>
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<tr>
<td>Heat Traced Sanitary</td>
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<td>MF</td>
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<td>Condensate Drain</td>
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<td>ASJ-SSL</td>
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<td>Roof Drain Bodies</td>
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<td>½”</td>
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<tr>
<td>Field Insulated HW Storage Tanks</td>
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<td>MF - Mineral-Fiber</td>
<td></td>
<td>CG</td>
<td>Cellular Glass</td>
<td></td>
</tr>
<tr>
<td>FE - Flexible Elastomeric</td>
<td></td>
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<td></td>
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</tbody>
</table>

2.13. LAVATORIES AND SINK INSULATION
A. Insulate all exposed hot, cold and waste piping associated with lavatories and sinks with Truebro “Handi Lav-Guard” insulation kit model no. 102. Equivalent by Brocar Products Inc. or Proto P-trap and valve covers.

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.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use de-mineralized water.

3.3. GENERAL INSTALLATION REQUIREMENTS
A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
B. All portions of piping shall be insulated, including inside walls, chases and other concealed spaces.
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 insulation with longitudinal seams at top and bottom of horizontal runs.
F. Install multiple layers of insulation with longitudinal and end seams staggered.
G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
H. Keep insulation materials dry during application and finishing.
I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive.
recommended by insulation material manufacturer.
J. Install insulation with least number of joints practical.
K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
Q. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

R. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

3.4. PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Penetration Firestopping and fire-resistant joint sealers.
C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping.
3.5. EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
   a. Do not weld anchor pins to ASME-labeled pressure vessels.
   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
   d. Do not overcompress insulation during installation.
   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
   f. Impale insulation over anchor pins and attach speed washers.
   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6. GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times
the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7. CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Domestic Water Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
   4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer’s written instructions.
   2. When preformed insulation sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
   3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:
   1. Install mitered segments of cellular-glass insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   2. Install insulation to flanges as specified for flange insulation application.
   3. Finish valve and specialty insulation same as pipe insulation.

3.8. CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
   4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer’s written instructions.
   2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10. MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing
insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.11. FIELD-APPLIED JACKET INSTALLATION
A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.
B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
E. Where PVDC jackets are indicated, install as follows:
   1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
   2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
   3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
   4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
   5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.12. 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 Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
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.
3.13. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
   1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
   2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Plumbing Contractors expense at no cost to owner.

END OF SECTION 220700
SECTION 221100 – PLUMBING PIPING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1. PIPING MATERIALS

A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. See piping material schedule at end of this Section for materials to be used for each piping system.

1. Cast Iron Bell and Spigot Soil Pipe
   a. Pipe and fittings shall be gray cast iron bell and spigot conforming to ASTM A-74.
   b. Seal joints with neoprene gaskets conforming to ASTM C-564.
   c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
   d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

2. Hubless Cast Iron Soil Pipe
   a. Pipe and fittings shall be gray cast iron conforming to CISPI 301.
   b. Pipe joints shall be no-hub heavy duty couplings consisting of neoprene rubber sleeve conforming to ASTM C-564 and mfg. by Husky SD 4000, Clamp all-125 or MG. Equivalent Mission Heavyweight couplings.
   c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
   d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

3. Ductile Iron Pipe:
   a. Pipe
      i. Ductile iron shall be ANSI A21.51, AWWA C151. All pipe joints shall be mechanical unless otherwise indicated. Pipe shall be color coded by blotes of paint. The Contractor shall submit a “color class” schedule of the pipe as marked by the manufacturer.
      ii. Inside coating shall be cement-mortar lining with seal coat of bituminous material in accordance with ANSI A21.4.
      iii. American Water Works Associations (AWWA) Standards: C151-86 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for water, or other liquids.
   b. Ductile Iron Pipe Joints and Fittings:
      i. Joints: Ductile iron shall be mechanical joints of the latest approved design of the manufacturer. Joints shall be so designed to guarantee a water-tight joint for the life of the pipeline.
      ii. Fittings: Ductile iron shall be short body mechanical as shown on the drawings, or required of the same pressure design as the pipe. Dimensional control and joint design shall conform to ANSI Standard A21.10 and A21.11. All fittings shall be coated as specified for the pipe. Where rods or ties are shown or called for, fittings shall be provided with anchoring lugs.

4. Carbon Steel Pipe (1/8” thru 2”):
a. Pipe:
   i. Provide seamless carbon steel conforming to ASTM specification A-106.
   ii. Pipe joints shall be threaded conforming to ANSI Standard B2.1.

b. Carbon Steel Welding Fittings:

c. Branch Connection Welding Fittings:
   i. Provide carbon steel weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM specification A105, Grade 11.

d. Branch Connection, Welding to Screwed Fitting:
   i. Provide carbon steel threadolet fitting conforming to ANSI Standards B16.9, B16.11, B31.1, and ASTM Specification A105, Grade 11.

e. Carbon Steel Flanges:
   i. Provide carbon steel flanges conforming to ASTM Specification A181, Grade 1, and ANSI Standard B16.5.

f. Malleable Iron Screwed Fittings:

g. Cast Iron Screwed Fittings:
   i. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.

h. Roll Grooved Pipe Couplings:
   i. Provide Victaulic style #107 or approved equal style (zero flex) couplings with Grade “E” gasket (EPDM compound) in mechanical areas. Provide Victaulic style #177 or approved equal style (flexible) couplings with Grade “E” gasket in other areas. Provide with ductile iron housing and nuts and bolts.
   ii. Equivalent by Grinnell.

5. Carbon Steel Pipe (2-1/2” and above):
   a. Pipe:
      i. Provide electric resistance welded carbon steel pipe conforming to ASTM Specification A-53.
      ii. Pipe ends shall be beveled for welding.

   b. Carbon Steel Welding Fittings:

   c. Branch Connection Welding Fittings:
      i. Provide carbon steel weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM specification A105, Grade 11.

   d. Branch Connection, Welding to Screwed Fitting:
      i. Provide carbon steel threadolet fitting conforming to ANSI Standards B16.9, B16.11, B31.1, and ASTM Specification A105, Grade 11.

   e. Carbon Steel Flanges:
      i. Provide carbon steel flanges conforming to ASTM Specification A181, Grade 1, and ANSI Standard B16.5.

   f. Malleable Iron Screwed Fittings:

g. Cast Iron Screwed Fittings:
i. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.

h. Pipe Flange Gaskets:
i. Provide 1/16” thick asbestos free gaskets full face or ring type as required. Gaskets shall be factory cut.

ii. Gaskets by Durable Mfg. Co. or Garlock Company.

i. Roll Grooved Pipe Couplings:
i. Provide Victaulic style #107 or approved equal style (zero flex) couplings with Grade “E” gasket (EPDM compound) in mechanical areas. Provide Victaulic style #177 or approved equal style (flexible) couplings with Grade “E” gasket in other areas. Provide with ductile iron housing and nuts and bolts.

ii. Equivalent by Grinnell.

6. Copper Tube:

a. Tube/Pipe:
i. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule. Tubing joints shall be soldered, brazed or Viega Pro-Press style fittings. See schedule for joining method to be used.

ii. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.

b. Wrought Copper Fittings:
i. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22

ii. Fittings by Anaconda, Chase, Viega or Nibco.

7. Copper Tube Type ACR:

a. Pipe/Tube:
i. Provide hard temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B-88. Tubes shall be Type L or K as listed in schedule.

ii. Tubing joints shall be brazed.

iii. Pipe by Anaconda, Cerro, or Mueller.

b. Wrought Copper Fittings:
i. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22

ii. Fittings by Anaconda, Chase or Nibco.

8. Polyethylene Pipe Natural Gas Piping:

a. Provide polyethylene pipe for gas service conforming to ASTM D-1248. Pipe shall be UV stabilized.

b. SDR of 11.

c. Pipe by Driscopipe or equal.

9. Polyvinyl Chloride Drain Waste Pipe:

a. Pipe:
i. Provide Schedule 40 polyvinyl chloride solid core plastic drain waste and vent pipe conforming to ASTM D2665. Joints shall be properly cleaned, primed and glued where scheduled.

ii. Polyvinyl Chloride (PVC) Pipe & Fittings Cell Class 12454 B. ASTM D 2241 SDR-26

iii. Pipe by Charlot, Genova, Crestline or equal.

b. PVC Fittings:
PART 3 EXECUTION

3.1. PIPING INSTALLATION

A. Piping systems materials and installation shall conform to the following standards and codes.

1. System: Natural Gas Piping


B. No piping containing water shall be located in areas subject to freezing temperatures, including: unheated attics, unheated plenums, chases wall spaces or cavities within exterior walls, under slabs, or in concrete.

C. Pipe sizes indicated on plans and as specified refer to nominal size in inches, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.

D. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings.

E. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer’s recommendations for fixed hanger and supports.

F. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.

G. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be 3/4".

H. Drain valves on closed piping systems such as chilled water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.

I. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.

J. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed and control valves with unions adjacent to each piping connection. Provide screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line.

K. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.

L. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricate pipe threads with Teflon thread sealant and lubricating compound applied full strength. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.

M. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.

N. Soft soldered socket type joints shall be made with sill-floss or 95-5 tin-antimony solder as required by
temperature and pressure rating of piping system. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.

O. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

3.2. PIPING SUPPORTS, ANCHORS, SLEEVES AND SEALS

A. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor.

B. Plumbing Contractor shall supervise installation of sleeves to insure proper location and installation.

C. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.

D. Sleeves passing through above grade floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.

E. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.

F. Pipe insulation shall run continuous through pipe sleeves with ¼” minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8” wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.

G. Pipe wall penetrations exposed to view shall have tight fitting escutcheons or flanges to cover all voids around openings.

H. All below grade and exterior wall penetrations shall be installed in a pipe sleeve and sealed between the pipe and pipe sleeve with Thunderline High Temperature Link Seal.

I. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around cables with Nelson “Flameseal” fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

J. Equivalent by Dow, Chemelex, 3M.

3.3. PIPE HANGERS AND SUPPORTS

A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58.

B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments to that rod is vertical in hot position.

D. Hangers shall not become disengaged by movements of supported pipe.

E. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.

F. Unless indicated otherwise on drawings support horizontal steel piping as follows:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>ROD DIAMETER</th>
<th>MAXIMUM SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1-1/4&quot;</td>
<td>3/8&quot;</td>
<td>8 Ft.</td>
</tr>
<tr>
<td>1-1/2&quot; to 2&quot;</td>
<td>3/8&quot;</td>
<td>10 Ft.</td>
</tr>
<tr>
<td>2-1/2&quot; to 3-1/2&quot;</td>
<td>½&quot;</td>
<td>12 Ft.</td>
</tr>
</tbody>
</table>
G. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

<table>
<thead>
<tr>
<th>NOM. TUBING SIZE</th>
<th>ROD DIAMETER</th>
<th>MAXIMUM SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1&quot;</td>
<td>3/8&quot;</td>
<td>6 Ft.</td>
</tr>
<tr>
<td>1-1/4&quot; to 1-1/2&quot;</td>
<td>3/8&quot;</td>
<td>8 Ft.</td>
</tr>
<tr>
<td>2&quot;</td>
<td>3/8&quot;</td>
<td>9 Ft.</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>½&quot;</td>
<td>9 Ft.</td>
</tr>
<tr>
<td>3&quot; and 4&quot;</td>
<td>½&quot;</td>
<td>10 Ft.</td>
</tr>
</tbody>
</table>

H. Support horizontal cast iron soil pipe with two hangers for each section located close to each hub.
I. Support vertical cast iron soil pipe at every floor, steel and copper tubing at every other floor except where indicated otherwise on drawings.
J. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used.
K. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect-Engineer for review prior to fabrication.
L. Provide Grinnell pipe hangers for vertical pipe risers as follows:

<table>
<thead>
<tr>
<th>PIPE MATERIAL</th>
<th>PIPE SIZE</th>
<th>HANGER FIG. NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>½&quot; thru 4&quot;</td>
<td>CT-121</td>
</tr>
<tr>
<td>Steel</td>
<td>½&quot; thru 20&quot;</td>
<td>261</td>
</tr>
</tbody>
</table>

M. Provide Grinnell Fig. 194, 195 or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.
N. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation.
O. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing. Provide wood block at each pipe hanger in thickness of insulation. Insulation vapor barrier jacket shall overlap wood block to maintain vapor barrier.

3.4. INSULATION MATERIALS AND APPLICATION METHODS (HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS, ETC.)

A. Insulation materials and application methods for piping hangers supports, anchors, guides expansion joints, etc., shall be as follows:
   1. Insulate hangers and supports from direct contact with cold or hot surfaces (-120°F to 450°F) with "Buckaroos Inc." or approved equal pipe insulation support system or similar rigid calcium silicate insulation at suspension points to prevent crushing of insulation.
   2. The length or thickness of the insulation support same as the pipe insulation thickness. Provide ASJ type discs or otherwise reestablish vapor barrier.
B. Structural attachments for pipe hangers shall be as follows:
C. Concrete Structure: Provide Grinnell Fig. No. 285 cast in concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge cast in type concrete insert for loads up to 1200 lbs.
D. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

<table>
<thead>
<tr>
<th>PIPE MATERIALS</th>
<th>PIPE SIZE</th>
<th>HANGER FIG. NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>½&quot; thru 4&quot;</td>
<td>CT-65</td>
</tr>
<tr>
<td>Steel</td>
<td>¾&quot; thru 4&quot;</td>
<td>65</td>
</tr>
<tr>
<td>Steel</td>
<td>5&quot; thru 30&quot;</td>
<td>260</td>
</tr>
</tbody>
</table>
E. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

<table>
<thead>
<tr>
<th>PIPE MATERIALS</th>
<th>PIPE SIZE</th>
<th>CLAMP NO.</th>
<th>ROLLER NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>3/8” thru 4”</td>
<td>8600 CP*</td>
<td>8010 CP*</td>
</tr>
<tr>
<td>Steel</td>
<td>3/8” thru 6”</td>
<td>8500</td>
<td>8010</td>
</tr>
</tbody>
</table>

*Copper Plated

F. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Elcen or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Architect-Engineer for review prior to fabrication.

G. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

H. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.

I. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Architect-Engineer prior to installations.

J. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Bee Line, Elcen, Fee & Mason, Fluorocarbon Company, Unistrut or Super Strut Inc.

K. Provide polycarbonate pipe support for piping located on flat roofs, unless otherwise indicated on drawings. Support will be of modular stackable design with a nylon roller bearing directly supporting pipe and a preformed saddle to keep piping on roller bearing. Maximum pipe support spacing shall be 10’. Provide pipe supports from Miro Industries, or approved equivalent, in the following sizes:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MODEL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2&quot;</td>
<td>02</td>
</tr>
<tr>
<td>2 ½” thru 4”</td>
<td>24R</td>
</tr>
</tbody>
</table>

END OF SECTION 221100
SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 220500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Field quality-control test reports.
   C. Operation and maintenance data.

1.3. QUALITY ASSURANCE
   A. NSF Compliance:
      2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1. INSULATING UNIONS AND FLANGES
   A. Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturers name and pressure class rating. Unions and flanges shall be as follows:
      1. Steel pipe to steel pipe screwed end:
         a. Provide Stockham malleable iron No. 693-1/2 insulating union with high dielectric strength insulating sleeve and gasket.
      2. Steel pipe to steel pipe flanged end:
         a. Provide two weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.
      3. Iron or steel pipe to copper pipe:
         a. Provide Epco Dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.

2.2. UNIONS
   A. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.
   B. Provide Stockham brass seat unions of material and pressure rating required by piping system.
   C. Where piping systems of dissimilar materials are jointed together provide proper insulating union as specified under this specification.
   D. Equivalent unions by Fairbanks or Grinnell.

2.3. 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. If retaining more than one screen size, indicate screen size on Drawings.
      6. Perforation Size:
         a. Strainers NPS 2 and Smaller: 0.062 inch
         b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
c. Strainers NPS 5 and Larger: **0.125 inch.**


B. Install strainers upstream from automatic control valves, water service backflow preventers and RPZ backflow preventers 1" and larger. Where strainers are an integral part of these items or incorporated in accessory equipment directly upstream, individual line strainers will not be required. Strainers shall be same size as piping. Provide strainers with proper isolation and blow down valves to allow basket removal for cleaning.

C. Install strainer so that basket contains debris by gravity at no flow conditions to allow removal of large debris not able to be passed by blow down.

### 2.4. TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:

1. Acorn Engineering Co.
4. Leonard Valve Company.
5. Powers; a Watts Industries Co.

   c. Type: Cabinet-type, thermostatically controlled water mixing valve.
   d. Material: Bronze body with corrosion-resistant interior components.
   e. Connections: Threaded union inlets and outlet.
   f. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
   g. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
   h. Valve Finish: Rough bronze.
   i. Piping Finish: Copper.
   j. Cabinet: Factory-fabricated, stainless steel, for recessed applications in finished spaces and surface mounting in plumbing spaces and with hinged, stainless-steel door.

### 2.5. HOSE BIBBS

4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
13. Include operating key with each operating-key hose bibb.
14. Include integral wall flange with each chrome- or nickel-plated hose bibb.

### 2.6. WALL HYDRANTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Prier Products, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with locking cover.
12. Operating Keys(s): One with each wall hydrant.

2.7. FLEXIBLE PUMP CONNECTIONS

A. Resistoflex Model R6904, multiple arch contour molded virgin fine powder/paste extrusion grade of Teflon TFE62, ASTM D-1457, Type III Teflon bellows with stainless steel reinforcing rings, 150# ASA drilled, adjustable control units have complete insulating grommets, and published dynamic pressure/temperature rating. Dupont TFE T62 Fluoroflex T-1001.

2.8. GAS PRESSURE REGULATORS

A. Provide gas pressure regulators with internal relief and low pressure cut-off as manufactured by Fisher Controls or Equimeter. Units shall be of size capable of capacities and pressures as shown on plans or as required for proper service. Verify capacities and pressures with each piece of equipment served.

2.9. DOMESTIC HOT WATER EXPANSION TANKS

A. The expansion tank shall be welded steel, diaphragm type tank, and pre-charged to the minimum operating pressure. Tanks shall be suitable for domestic water service.
B. Provide expansion tanks as shown on plans by Amtrol, Bell and Gossett, Watts.

2.10. WATER HAMMER ARRESTERS:

A. ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F. Manufacturers: Amtrol, Josam, Sioux Chief, Watts, Zurn.
B. Provide water hammer arrestors for all plumbing banks with fixtures utilizing flush valves in any capacity.Locate arrester between the last two fixtures served on the branch line. Water Closet = 10FU, Urinals = 5FU, Lavatories = 1.5FU.

<table>
<thead>
<tr>
<th>FIXTURE UNITS (FU)</th>
<th>UNIT SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-11</td>
<td>A</td>
</tr>
<tr>
<td>12-32</td>
<td>B</td>
</tr>
<tr>
<td>33-60</td>
<td>C</td>
</tr>
<tr>
<td>61-113</td>
<td>D</td>
</tr>
<tr>
<td>114-154</td>
<td>E</td>
</tr>
<tr>
<td>155-330</td>
<td>F</td>
</tr>
</tbody>
</table>

C. When no flush valves are installed on a branch of piping provide ¾”x12” air chambers at each hot and cold water supply connection to a plumbing fixture. Contractor may provide water hammer arresters above the ceiling before dropping into masonry construction in lieu of air chambers. Connections to other items such as washers, ice makers, or other equipment shall be provided with an appropriately sized water hammer arrester for each water connection.

2.11. RECIRCULATION PUMPS

A. The pump shall be of the horizontal, oil-lubricated type and of all bronze construction. Specifically designed and guaranteed for quiet operation. Suitable for 125# working pressure.
B. The pump shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall
be supported by two horizontal sleeve bearings designed to circulate oil. The pump is to be equipped with a mechanical seal with carbon seal face rotating against a ceramic seat. The motor shall be non-overloading at any point on pump curve.

C. The motor shall be of the drip-proof, sleeve-bearing, quiet-operating, rubber-mounted construction. Motors shall have built-in thermal overload protectors.

D. Provide pump with aquastat or built in temperature control/timer system.

E. Equivalents pumps by Grundfos, Armstrong, Bell & Gossett and Taco.

2.12. THERMOMETERS AND GAUGES

A. Provide thermometers and wells and pressure test plugs as hereinafter specified and shown on the plans so that proper testing and balancing and trouble shooting can be accomplished.

B. THERMOMETERS

1. Thermometers shall be red reading mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Trerice or Weksler.

2. Install thermometers at eye level (5'-0") at easily readable locations.

C. GAUGES

1. Gauges shall be bourdon tube with minimum 4-1/2" dial and die cast aluminum case with black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube brazed at socket and tip. The accuracy of the gauge shall be within ½ percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure, compound, and differential pressure gauges shall have suitable scale ranges, shall be submitted and are subject to the review of the Engineer. Graduations shall be one pound or less on all gauges where this is standard for the required range.

2. Gauges shall have ¼" IPS connections and shall be Moeller “Vantage” gauges with Case Style No. 2, or approved equal. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Ashcroft, Marsh, Trerice, Moeller, Weksler, Taylor, Weiss, or Midwest.

3. Install a Sisco ¼” or ½” NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8” o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1000 psig.

4. Install gauges vertically.

D. INSTALLATION

1. Thermometers shall be installed as hereinafter specified. Where thermometer is scheduled, a thermometer well shall be provided.

2. All thermometer wells shall be constructed of brass or stainless steel and where installed in insulated piping shall have at least 2-1/2" lagging extension. Gauges shall be installed as hereinafter specified.

3. Gauge cocks shall be polished brass A10 ¼” tee handle type with threaded ends. 125 psi rated.

4. Provide gauge cock with ¼" pipe nipple for connection to gauge cock.

5. Pressure temperature ratings of each well shall be suitable for the system in which it is installed in accordance with specifications and as indicated on the drawings. All wells shall be filled with Silicon and be complete with caps and chains.

6. Thermometers shall have the temperature ranges as required for the intended application and shall be installed as scheduled.

E. THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>Thermometer &amp; Well</th>
<th>Press Gauge &amp; Gauge Cock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot water entering and leaving heaters</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hot water entering and leaving storage tanks</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Water Service ahead of PRV</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
PART 3 EXECUTION

3.1. INSTALLATION

A. Refer to other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to plumbing 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. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

   1. Install thermometers and water regulators if specified.
   2. 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 control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section “Identification for Plumbing Piping and Equipment.”

3.2. FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

   1. Test each backflow preventer 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.

3.3. ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119
SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

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

1.2. SUMMARY
A. This Section includes the following sanitary drainage piping specialties:
   1. Backwater valves.
   2. Cleanouts.
   3. Floor drains.
   4. Roof and Overflow Drains
   5. Downspout Nozzles
   6. Trench drains.
   7. Channel drainage systems.
   9. Roof flashing assemblies.
   10. Through-penetration firestop assemblies.
   11. Miscellaneous sanitary drainage piping specialties.

1.3. SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Cleanouts.
   2. Floor drains.
   3. Trench drains.

1.4. QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

2.1. CLEANOUTS
A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated below or a comparable product by one of the following:
   2. Sioux Chief Manufacturing Company, Inc.
   4. Tyler Pipe; Wade Div.
   5. Watts Drainage Products Inc.
B. Floor (Concrete Floor Finish):
   1. Wade #W-6000-XS cast iron cleanout with square, heavy duty, scoriated nickel bronze top, adjustable above to finished floor.
C. Floor (Quarry Tile Floor Finish):
   1. Same as concrete floor finish.
D. Floor (Tile Floor Finish):
   1. Wade #W-6000-TS cast iron cleanout with square heavy duty nickel bronze top, recessed for tile and adjustable to finished floor.
E. Floor (Carpet Floor Finish):
   1. Wade #W-6000-XS-72 cast iron cleanout with round, heavy duty nickel bronze top with carpet retainer and adjustable to finished floor after concrete has set.

F. Wall:
   1. Wade #W-8450-C cleanout with dura-coated cast iron ferrule and cadmium plated cast iron counter-sunk plug complete with round smooth nickel bronze wall access cover and flush over-wall frame.

G. Verify floor materials used from Architectural plans and provide proper cleanout tops, where they occur in carpet, quarry tile, vinyl tile or ceramic tile.

2.2. FLOOR DRAINS
A. Cast-Iron Floor Drains:
   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:
      b. MIFAB, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zum Plumbing Products Group.
   2. Standard: ASME A112.6.3.
   4. Seepage Flange: Required for all elevated slabs.
   5. Anchor Flange: Required.
   7. Outlet: Bottom.
   8. Top or Strainer Material: Nickel bronze in public spaces or rough bronze in mechanical spaces unless otherwise scheduled.
   9. Top of Body and Strainer Finish:
   10. Top Shape: Square in tiled areas. All others shall be round.
   11. Dimensions of Top or Strainer: As scheduled.
   12. Trap Material: Cast iron.
   14. Trap Features: Trap-seal primer valve drain connection where shown on plans.

2.3. FLASHING MATERIALS
A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
   3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
D. Fasteners: Metal compatible with material and substrate being fastened.
E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
F. Solder: ASTM B 32, lead-free alloy.
G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.1. INSTALLATION
A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint
construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.
5. Not all required cleanouts are shown on the plans in the interest of drawing clarity. Cleanout that are shown are to be located as shown. Additional code required cleanouts shall be located to be along walls (not in middle of halls or large floor areas) and out of general sight lines where possible. Install cleanouts so they are accessible by extending them through walls, and floors, to outside of building, or to above grade as required.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
   b. Radius, 30 to 60 inches (750 to 1500 mm): Equivalent to 1 percent slope.
   c. Radius, 60 inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Retain one of first two paragraphs below.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

J. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

K. Install deep-seal traps on floor drains and other waste outlets.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2. CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet.
piping. Install valve on outlet of automatic drawoff-type unit.

E. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.

F. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3. FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4. PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319
SECTION 223300 – ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 220500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. ELECTRICAL WORK REQUIRED
A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

1.3. SUBMITTALS
A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
D. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
E. 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. 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. 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.
D. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

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.
C. Warranty Period: From date of Substantial Completion: Storage Tanks: 3 years.

PART 2 - PRODUCTS

A. ELECTRIC TANKLESS (INSTANTANEOUS) WATER HEATERS
   1. Unit shall have ABS-UL 94Vo rated cover.
   2. Element shall be replaceable cartridge insert. Unit shall have replaceable filter in the inlet connector. Element shall be iron free, nickel chrome material. Heater shall be fitted with compression nuts.
   3. Electrical characteristics as scheduled. Coordinate with electrician for wiring requirements.
   4. Maximum operating pressure of 150 PSI.
   5. Coordinate mounting of unit to be out of view as much as possible and maintain piping, service and ADA clearances under lavatory.

B. POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS 30 GALLONS AND LESS
1. Provide water heaters as scheduled by State, Rheem, Eemax, A.O. Smith, Bosch. Refer to schedule for capacities and characteristics.

2. Storage Tank Construction: Steel with 150-psig working-pressure rating.

3. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.

4. 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.

5. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.


8. Temperature Control: Adjustable thermostat for each element.


10. Drain Valve: ASSE 1005, factory installed.

11. Electrical characteristics as scheduled. Coordinate with electrician for wiring requirements.

12. Provide with 3 year warranty.

13. Where unit is suspended provide adequate supports and shelf. Mount above ceiling where ceiling is accessible. Mount all components for heater where suspended or wall mounted no lower than 6'-8" above finished floor.

14. Where unit is located in cabinetry or under sinks, take care to coordinate with other trades and piping to provide all adequate clearances and serviceability.

C. COMMERCIAL, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS LARGER THAN 30 GALLONS

1. Provide water heaters as scheduled by State, Rheem, A.O. Smith, PVI. Refer to schedule for capacities and characteristics.

2. Description: Comply with UL 174 or UL 1453, and listed by manufacturer for commercial applications.

   a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
   b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
   d. Jacket: Steel, with enameled finish.

4. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.
   a. Temperature Control: Adjustable thermostat.

5. Anode Rod: Factory installed, magnesium.


7. Special Requirement: NSF 5 construction.

8. Provide water heaters as scheduled by State, Rheem, National, or A.O. Smith. Refer to schedule for capacities and characteristics.

9. Units shall have a porcelainized glasslined tank, protected in the following ways:
   a. Against failure due to overheating caused by the buildup of scale, film and other sediment by a cold water inlet tube, which is an integral part of the heater, that churns and agitates particles of sand, silt or scale present in the water, so they are carried out of the water heater on successive hot water draws.
   b. Against electrolytic corrosion by conveniently located, easily replaceable magnesium anode rods.

10. Water heaters shall have the U.L. seal of certification, a working pressure rating of 160 psi, a factory installed Temperature and Pressure Relief Valve, and a full-size (4"x5") inspection port. Water heater shall also be equipped with N.S.F. construction.

11. Water heater tanks shall be covered by a 3 year limited warranty against failure due to metal fatigue and overheating caused by buildup of sand, sediment or sludge.
PART 3 - EXECUTION

3.1. 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 seismic restraints for water heaters where located in seismic zones. Anchor to substrate.

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 Division 22 Section "Plumbing Specialties" for drain valves.

J. Install temperature and 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.

K. Install temperature and 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.

L. 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 Division 15 Section "Valves" for general-duty valves and Division 22 Section "Meters and Gages" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Fill water heaters with water.

O. Charge compression tanks with air.

3.2. CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.

D. Make connections with dielectric fittings where piping is made of dissimilar metal.

E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.

F. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. 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.

3.4. 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 date in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 223300
SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 220500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. ELECTRICAL WORK REQUIRED
   A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

1.3. PIPING SYSTEMS
   A. Refer to Section 221116 of this specification for piping material specifications and installation instructions. Specific piping materials and joining methods for systems installed under this section shall be as listed in schedule.

1.4. PIPING SYSTEMS VALVES
   A. Refer to Section 22 “Valves” of this specification for valve type specifications and installation instructions.

1.5. PIPING SYSTEMS INSULATION
   A. Refer to Section 22 “Insulation” insulation type specifications and installation instructions.

PART 2 - PRODUCTS

2.1. MANUFACTURERS
   A. Equivalent fixtures and accessories by following manufacturers will be acceptable.
   1. Fixtures: American Standard, Kohler, Crane, Zurn, Toto.
   2. Institutional/Correctional: Bradley, or Acorn
   3. Stainless Steel Fixtures: Elkay, Just, Moen Commercial
   4. Fittings and Supports: Josam, Smith, Wade, Zurn, or Jonespec.
   5. Seats: Church, Olsonite, Bemis or Beneke.
   8. Traps, Supplies and Stops: Dearborn, Brass Craft, Central D, Sanitary Dash or as specified under plumbing fixtures.
      a. Supplies and Stops: Dearborn Fig. No. 2700 CW ½” compression loose key stop and 3/8” O.D. risers in length required. Provide deep chrome plated brass escutcheons.
      b. Traps: Dearborn #FS510 (1-1/2”) and/or EFS507 (1-1/4") cast brass body with clean-out and 17 gauge tube outlet “P” trap. Provide deep chrome plated brass escutcheon with set screw.

2.2. PLUMBING FIXTURES
   A. Provide plumbing fixtures as shown on drawings and as specified complete including piping and connections. China fixtures shall be of best grade vitreous ware without pit holes or blemishes and outlines shall be generally true. Architect-Engineer reserves right to reject any piece, which in their opinion is faulty. Fixtures fitting against walls shall have ground backs. Exposed piping and fittings shall be chrome plated.
   B. All wall mounted urinals and lavatories shall be furnished with concealed arm carriers. All wall-mounted water closets shall be furnished with concealed carriers.
   C. Set fixtures true and level with all necessary supports for fixtures installed before wall finish is done. Nipples through wall to fixture connections shall be chrome plated brass. Provide silicone sealer around perimeter of lavatories, water closets, and urinals at connection to wall and/or floor.

2.3. LAVATORY FAUCETS:
   A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
      1. American Standard Companies, Inc.
      2. Bradley Corporation.
      3. Chicago Faucets.
4. Delta Faucet Company.
5. Eljer.
6. Kohler Co.
7. Moen Commercial
8. Zurn Plumbing Products Group; Commercial Brass Operation.

B. Description: Single-control mixing, Single-control nonmixing, and Two-handle mixing as scheduled valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

1. Body Material: Commercial, solid brass
2. Finish: As Scheduled.
3. Maximum Flow Rate: 0.5 gpm (1.5 L/min.) for public lavatories. Private lavatories shall be a maximum of 2.2 gpm (8.3 L/min.)
4. Centers: As scheduled and coordinated with fixtures.
5. Valve Handle(s): ADA Compliant wrist blade, 4 inches (102 mm) unless otherwise scheduled.
7. Spout Outlet: As scheduled.
8. Tempering Device: Provide thermostatic tempering device piped in supply for all public lavatories unless tempering is otherwise provided.
9. Where electronic fixtures are specified, provide all transformers, cables, junction boxes, sensors and controls. All equipment and installation shall have neat and orderly appearance.

2.4. FLUSHOMETERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Sloan.
2. Zurn.
3. Toto.

B. Description: Flushometers for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

1. Internal Design: Diaphragm or piston operation as scheduled.
2. Style: Exposed or Concealed as scheduled.
3. Consumption: Low flow type coordinated with flow requirements of fixture served.
4. Tailpiece Size: Coordinated with spud of fixture and length as required for valve location to properly mounted fixture elevation.

C. Provide recessed vandal proof covers and boxes for all recessed/concealed style flush valves.
D. Provide all required junction boxes, power supplies and wiring for line voltage style flush valves when scheduled.
E. All exposed components shall be chrome finished or brushed nickel or similar durable finish.

2.5. PROTECTIVE SHIELDING GUARDS
A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Engineered Brass Co.
   b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
PART 3 EXECUTION

3.1. GENERAL
A. All plumbing fixtures shall be cleaned and free of all construction debris.
B. Electric water cooler shall be protected during construction.
C. Any chrome trim with wrench marks shall be removed and new trim installed.
D. Architect-Engineer reserves the right to reject any plumbing fixture.
E. See plans for Plumbing Fixture Schedule.

3.2. INSTALLATION
A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers’ written instructions.
B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
E. Install wall-mounting fixtures with tubular waste piping attached to supports.
F. Install fixtures level and plumb according to roughing-in drawings.
G. 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.
H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
J. 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.
K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
L. Install toilet seats on water closets.
M. 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.
N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
O. 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.
P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
Q. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
S. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck where sink is stainless steel type or on countertop at sink where sink is integral or there is no deck for sink. Connect inlet hose to dishwasher and outlet hose to disposer.
T. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
U. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Basic Plumbing Materials and Methods."
V. Set bathtubs and showers in leveling bed of cement grout.
W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3. CONNECTIONS
A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Ground equipment according to Division 26 Section "Grounding and Bonding."
D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4. FIELD QUALITY CONTROL
A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
E. Install fresh batteries in sensor-operated mechanisms.

3.5. PROTECTION
A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000
END OF DIVISION 220000
DIVISION 23
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PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Mechanical Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK
A. This DIVISION requires the furnishing and installing of complete functioning Mechanical systems, and each element thereof, as specifically or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system’s functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
B. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS
A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, FAX 913-492-2437, EMAIL admin@pkmreng.com.
B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.
D. “PROVIDE” means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
E. “INSTALL” means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
F. “FURNISH” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
G. “WIRING” means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
H. “CONDUIT” means the inclusion of all fittings, hangers, supports, sleeves, etc.
I. “AS DIRECTED” means as directed by the Architect/Engineer, or his representative.
J. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS
A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS
A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES
A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.
1.7. LOCATIONS AND INTERFERENCES
   A. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the mechanical drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.
   B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
   C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.
   D. Do not scale mechanical and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicated on the Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE
   A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
   B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

1.9. WARRANTY
   A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor’s expense.
   B. Warranty for all equipment shall take effect from the date of substantial completion regardless of the date equipment was installed.
   C. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES
   A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS
   A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner’s best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
   B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
   C. In general, these specifications identify required materials and equipment by naming one or more manufacturer’s brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
   D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
   E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer’s name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
   F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they
shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer’s descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer’s certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES
A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. TEMPORARY USE OF PERMANENT HVAC UNITS
A. If the Contractor elects to use permanent equipment for temporary conditioning only that permanent equipment associated with the heating system shall be allowed for use as space conditioning during the construction period. The Mechanical Contractor shall take full responsibility for all permanent equipment used for temporary conditioning during the construction period and shall provide a total of two years warranty covering all parts and labor on all permanent equipment utilized for temporary conditioning. This warranty shall cover all piping, fittings, valves, pipe and equipment insulation, pumps, boilers, chillers, condensing units, cooling towers, air handling units, exhaust and relief air fans, ductwork, ductwork insulation, diffusers, temperature controls, all electric motors, starters, disconnect switches, fuses, wire and conduit. This warranty shall cover all required maintenance on the system with the exception of filter changes, and shall start on the date shown on the final completion certificate.
B. CAUTION: The Contractor is being warned that the Architect-Engineer will not accept dirty equipment caused by construction contamination.

1.14. OPENINGS, ACCESS PANELS AND SLEEVES
A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.
B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.15. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS
A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.16. EXTENT OF CONTRACT WORK
A. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for “Extra Work” be allowed for work about which Contractor could have been informed before bids were taken.
B. Electrical work required to install and control mechanical equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor’s base bid proposal. Mechanical systems and components are to be installed as a complete system, including all miscellaneous interlock (low voltage and minor line voltage power wiring such as control motors, limit switches, relays, etc), control wiring, safeties. Coordinate interlock to other systems such as fire alarm that interlock to mechanical systems and insure that provisions are made in equipment for connection of these systems. Coordinate with all other trades for specific needs and requirements based on submitted systems.

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MECHANICAL PROVISIONS
C. Contractor shall become familiar with equipment provided by other contractors that require mechanical connections and controls.

D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.

E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Mechanical Contractor at no cost to Owner or Architect-Engineer.

F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.

H. Contractor shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

1.17. WORK NOT INCLUDED IN CONTRACT

A. Consult Division 26 of specifications for work to be provided by Electrical Contractor in conjunction with installation of mechanical equipment.

1.18. CODES, RULES AND REGULATIONS

A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.

B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.19. SAFETY CODES:


B. Occupational Safety and Health Standard (OSHA) - Department of Labor.

1.20. NATIONAL FIRE CODES:


E. NFPA No. 69M Clearances, Heat Producing Appliances


1.21. UNDERWRITERS LABORATORIES INC:

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.22. MISCELLANEOUS CODES:

A. ANSI A117.1 - Handicapped Accessibility

B. Applicable State Boiler Codes

C. Americans with Disabilities Act (ADA)

1.23. ENERGY EFFICIENCY REQUIREMENTS:

A. All mechanical systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 - 2007 and latest adopted version of IECC.

1.24. STANDARDS

A. Drawings and specifications indicate minimum construction standard. Should any work indicated be
sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.25. PERMITS/FEES

A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.

B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

PART 2 - PRODUCTS

2.1. Not Used

PART 3 - EXECUTION

3.1. SHOP DRAWINGS

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.

B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.

C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer’s name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor’s approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor’s submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor’s approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor’s approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor’s review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor’s stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect-Engineer’s checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect-Engineer’s attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised “flagged” or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible...
and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Sheet metal shop drawings for duct fabrication shall be a minimum of 1/4" scale. Sheet metal shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans, fittings, reinforcement and spacing, seam and joint construction, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.

L. Architect-Engineer’s review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer's review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor's responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (e.g., Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

1. BASIC MECHANICAL MATERIALS AND METHODS:
   a. Test methods and pressures
   b. Piping, and fittings

2. PIPING:
   a. Piping specialties
   b. Supports, anchors
   c. Sleeves and seals
   d. Valves
   e. Piping and equipment insulation
   f. Thermometers and gauges

3. SHEET METAL:
   a. Ductwork
   b. Ductwork materials
   c. Sheet metal specialties and ductwork accessories
   d. Exhaust hoods
   e. Ductwork insulation
   f. Grilles, registers and diffusers
   g. Breechings, chimneys and stacks

4. HVAC HYDRONIC EQUIPMENT:
   a. Pumps
   b. Boilers
   c. Chillers
   d. Hydronic system components and specialties
   e. Chemical water treatment

5. HVAC AIR SIDE EQUIPMENT:
   a. Air handling units
   b. Variable air volume boxes
   c. Blower coil units
   d. Furnaces, evaporators & condensing units
   e. Rooftop heating and cooling units
   f. Split system heat pumps
   g. Gas fired unit heater
   h. Through wall units
i. Condensing units
j. Ground source heat pumps
k. Ground source well loops
l. Indirect gas-fired make-up air handling unit
m. Exhaust fans
n. Air filters and housings
o. Rooftop heat pump units
p. Open coil duct heaters
q. Makeup air units
r. Duct furnaces

6. MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL:
   a. Vibration isolation
   b. Isolation of piping systems
   c. Isolation of fractional horsepower equipment
   d. Seismic Details, calculations and components.

7. SEISMIC CONTROL:
   a. Isolation of piping systems
   b. Seismic Mounting and Bracing Details
   c. Seismic hangers, isolators and other components.
   d. Engineered calculations and components.

8. SYSTEM TESTING & BALANCING:
   a. Testing Contractor
   b. Balance Report

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)
   A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
   B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
   C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:
      1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
      2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
      3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
      4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
   D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
      1. Project name and address.
      2. Section of work covered by brochure, i.e., “Plumbing”, etc.

3.5. RECORD DOCUMENTS
   A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
   B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
   C. Provide one copy of on high quality heavy weight presentation type paper. Blueprints or other media which fade shall not be used.
   D. Provide one electronic scanned version of record documents in Adobe PDF format on a DVD. Transmit DVD in conjunction with hard copy documents.
3.6. CLEANING UP
   A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
   B. Contractor shall clean up all ductwork and equipment at the completion of the project.
   C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

3.7. WATERPROOFING
   A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
   B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense.

3.8. CUTTING AND PATCHING
   A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
   B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
   C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of mechanical work shall be repaired at Contractor's expense to approval of Architect-Engineer.

3.9. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS
   A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
   B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced at no cost to Owner.
   C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
   D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Mechanical contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
   E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
   F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.

3.10. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK
   A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner’s operating personnel shall be present during these operations.
   B. Contractor shall be responsible for training Owner’s operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner’s personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.
   C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall
become property of the owner.

3.11. FINAL CONSTRUCTION REVIEW

A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 230500
SECTION 230505 – PROJECT COORDINATION

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.
   4. Requests for Interpretation (RFIs).

B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

1.3. COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

1.4. SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

   1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
      a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate required installation sequences.
      c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

   2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.

   3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.
1.5. COORDINATION

A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.

B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.

C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.

D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.

E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.

F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.

G. The Drawings show only the general run of piping and ductwork and approximate location of outlets. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.

H. Adjust location of piping, ductwork, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

   1. Right-of-Way:

      a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.

      b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

I. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.

J. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.

K. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.

L. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.

1.6. PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Organize meeting with agenda and invite all pertinent attendees. Notify Architect and owner of relevant meetings. Record all decisions made and distribute minutes within 3 days of meeting.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

   2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

      b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Possible conflicts.
i. Compatibility problems.
j. Time schedules.
k. Manufacturer's written recommendations.
l. Warranty requirements.
m. Compatibility of materials.
n. Space and access limitations.
o. Regulations of authorities having jurisdiction.
p. Testing and inspecting requirements.
q. Installation procedures.
r. Coordination with other work.
s. Required performance results.
t. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. Notify Architect of meeting.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.

b. Review present and future needs of each contractor present, including the following:

i. Interface requirements.
ii. Sequence of operations.
iii. Status of submittals.
iv. Deliveries.
v. Off-site fabrication.
vi. Access.
vii. Quality and work standards.
viii. Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.7. REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.

1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and
other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)
PART 3 EXECUTION (Not Used)

END OF SECTION 220505
PART 3 - EXECUTION

3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.

B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.

C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.

D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.

E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.

F. For test pressure schedules see piping material schedules.

3.2. TEST METHODS AND PRESSURES

A. Test methods and pressures shall be as follows:

   1. Hydrostatic Test (Closed Systems):
      a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.

   2. Hydrostatic Test (Open System):
      a. Test entire system with 10-foot head of water. Where system is tested in sections each joint in building except uppermost 10 feet of system shall be submitted to at least 10-foot head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.

   3. Pneumatic Test:
      a. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
      b. Allow at least 1 hour after test pressure has been applied before making initial test.
      c. Curing test, completely isolate entire system from compressor or other sources of air pressure.

   4. Pressure Relief and Safety Valve:
      a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
      b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
      c. Items installed in systems without test tag attached will be rejected.

3.3. TESTING OF REFRIGERANT LINES

A. After the system is installed and before any piping is insulated, the entire refrigeration circuit must be thoroughly leak tested. Test all pipe joints for leaks. Make certain that all joints are inspected thoroughly. Mark carefully any spots where leaks occur.
3.4. CLEANING OF SYSTEMS AND EQUIPMENT

A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

1. Air Handling Systems:
   a. Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment by mechanical contractor before final acceptance inspection by Architect and Engineer.

3.5. MAINTENANCE OF SYSTEMS

A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer’s recommendations.

3.6. PAINTING OF MATERIALS AND EQUIPMENT

A. Touch-up painting and refinishing of factory applied finishes shall be by Mechanical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
B. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
C. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
D. Where extensive refinishing is required equipment shall be completely repainted.

3.7. EXCAVATION AND BACKFILL

A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

3.8. FIRE BARRIERS

A. General
   1. For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and fire.
other gases, and maintain original fire-resistance rating of construction penetrated.

B. Submittals

1. Product Data: For Each Type Of Product Indicated.
2. Shop Drawings: For Each Through-Penetration Firestop System, Show Each Type Of Construction Condition Penetrated, Relationships To Adjoining Construction, And Type Of Penetrating Item. Include Firestop Design Designation Of Qualified Testing And Inspecting Agency That Evidences Compliance With Requirements For Each Condition Indicated.
   a. Submit Documentation, Including Illustrations, From A Qualified Testing And Inspecting Agency That Is Applicable To Each Through-Penetration Firestop System Configuration For Construction And Penetrating Items.
   b. Where Project Conditions Require Modification To A Qualified Testing And Inspecting Agency's Illustration For A Particular Through-Penetration Firestop Condition, Submit Illustration, With Modifications Marked, Approved By Through-Penetration Firestop System Manufacturer's Fire-Protection Engineer As An Engineering Judgment Or Equivalent Fire-Resistance-Rated Assembly.

3. Through-Penetration Firestop System Schedule: Indicate Locations Of Each Through-Penetration Firestop System, Along With The Following Information:
   a. Types Of Penetrating Items.
   c. Through-Penetration Firestop Systems For Each Location Identified By Firestop Design Designation Of Qualified Testing And Inspecting Agency.

C. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.
G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
H. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
I. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
J. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson “Flameseal” fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

3.9. EQUIPMENT ANCHORS

A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

3.10. WELDING

A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be
type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.

C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders’ code, date and types of latest qualification test passed by each welder.

D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 “Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing”. Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

END OF SECTION 230513
SEccion 230530 – Motor Control and Equipment Disconnects

Part 1 - General

1.1. Related Documents

A. Reference Section 230500.
B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

Part 2 - Products

2.1. Disconnect Switches

A. General

2. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, or Square D.

B. Product

1. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
2. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
3. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.

C. Execution

1. All fuse holders shall have rejection clips installed.
2. Mount switch enclosure rigidly and with proper alignment on building structure or steel supports with centerline of operating handle not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
3. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.
4. All disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.

End of Section 230530
SECTION 230593 – SYSTEM TESTING & BALANCING

PART 3 - GENERAL

3.1. RELATED DOCUMENTS
   A. Reference Section 230500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

3.2. TESTING AND BALANCING CONTRACTORS
   A. Testing and balancing (TAB) of the building air and hydronic systems will be to be completed near the end of construction. The Mechanical Contractor has responsibility to cooperate with, make adjustments for, and provide any equipment necessary for the TAB contractor to complete the job.

PART 4 - PRODUCTS

   A. Not Used

PART 5 - EXECUTION

5.1. SCOPE OF WORK
   A. The Contractor shall procure the services of an independent air balance and testing contractor, approved by the A/E, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust, and test air moving equipment and air distribution and exhaust systems and all water flow circuits. All work by this contractor shall be done under engineer employed by them. All instruments used by this contractor shall be accurately calibrated and maintained in good working order. If requested the tests shall be conducted in the presence of the A/E responsible for the project and/or his representative. The testing and balancing contractor shall be certified by NEBB or AABC and all work shall be performed in accordance with these organizations' published procedure manuals.
   B. The balancing contractor shall prepare a certified report of all tests performed. The report shall be written on standard forms prepared by NEBB or AABC or facsimiles thereof. The balancing contractor shall submit 3 copies of this report to the Mechanical Contractor who shall submit them to the A/E for review and distribution.
   C. Air balance and testing shall not begin until systems have been completed and are in full working order. All heating, ventilation, and air conditioning systems and equipment shall be in full operation during each working day of testing and balancing.

5.2. SYSTEM PREPARATION FOR TESTING AND BALANCING
   A. Prior to requesting testing and balancing contractor to perform their work the installing contractor shall make all necessary inspections and adjustments to insure that systems are completely installed and operating in accordance with the manufacturer's recommendations and the contract documents.
   B. The following checks shall be performed on each system installed under this contract. A report sheet shall be prepared for each system indicating checks made, corrective action taken where required, date, and name of person making inspection. Submit one copy to testing and balancing contractor and two to A/E. Testing and balancing contractor will not begin until checklist has been received and reviewed.

5.3. TEMPERATURE CONTROLS CONTRACTOR COORDINATION
   A. The temperature control contractor shall have a technical representative present with the balancing contractor on the first day of balancing for a minimum of four hours of active balancing and temperature controls coordination.
   B. For the remainder of the balancing the temperature contractor may either have a technical representative present, or may furnish the balancer with the latest DDC software and all required interface devices. This includes instructions and coordination in the use of all interface devices, including laptop computers. There shall be no charge to the balancing contractor for the use of these interface devices and they shall be returned to the temperature controls contractor at the end of the balancing process.

5.4. AIR HANDLING SYSTEMS:
   A. Clear system of all foreign objects and clean system.
   B. Verify fan rotation.
   C. Check bearing condition and lubrication.
   D. Check fan wheel clearances and fan alignment.

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E. Check motor security to mounting base.
F. Check alignment of drive.
G. Check vibration isolator adjustment.
H. Verify that proper filter media is installed.
I. Verify that all control dampers are installed and operable without binding or sticking.
J. Verify that all air terminal units are installed.
K. Confirm that all air openings in walls above ceilings have been provided.
L. Check for and repair all excessive air leaks in duct systems, at equipment connections and at coils.
M. Air leaks shall not exceed SMACNA parameters for system pressure.
N. Verify that ductwork is constructed and installed in accordance with contract drawings and/or approved ductwork shop drawings.
O. Inspect and clean all coils (including evaporator and condenser) and correct fin damage.

5.5. AIR SIDE TESTING AND BALANCING

A. GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

1. 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.
2. Prepare schematic diagrams of systems' "as-built" duct layouts.
3. For variable-air-volume systems, develop a plan to simulate diversity.
4. The TAB contractor shall cycle each air handling unit through its control sequence of operation to verify proper operation. Any inconsistency with contract documents shall be reported to A/E and temperature control contractor. Temperature control contractor shall take prompt action to correct any control inconsistency as reported by the TAB contractor.

5. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
6. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
7. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
8. Verify that motor starters are equipped with properly sized thermal protection.
9. Check dampers for proper position to achieve desired airflow path.
10. Check for airflow blockages.
11. Check condensate drains for proper connections and functioning.
12. Check for proper sealing of air-handling-unit components.
13. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

B. PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

1. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   a. Measure total airflow.
      i. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   b. Measure fan static pressures as follows to determine actual static pressure:
      i. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      ii. Measure static pressure directly at the fan outlet or through the flexible connection.
      iii. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      iv. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   c. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      i. Report the cleanliness status of filters and the time static pressures are measured.
d. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

e. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

f. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

g. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

2. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

   a. Measure airflow of submain and branch ducts.

   i. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

   b. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

   c. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

3. Measure air outlets and inlets without making adjustments.

   a. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

4. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

   a. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

   b. Adjust patterns of adjustable outlets for proper distribution without drafts.

5.6. TOLERANCES

   A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

      1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10% percent.
      2. Air Outlets and Inlets: Plus or minus 10 percent.

5.7. REPORTING

   A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

   B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

5.8. FINAL REPORT

   A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

      1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing
and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers’ test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer’s name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor, return, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Fan drive settings including settings and percentage of maximum pitch diameter.
   e. Settings for supply-air, static-pressure controller.
   f. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflow.
2. Duct, outlet, and inlet sizes.

5.9. AIR AND WATER BALANCE CONSTRUCTION COORDINATION

A. During installation of the mechanical systems the testing and balancing contractor shall make no less than (3) inspection visits to the project site. Proper placement and installation of all control and balancing devices shall be verified by these inspections. The mechanical contractor shall make all corrections in control and balancing device locations as requested by the TAB contractor. Following each inspection visit the TAB contractor shall report to the A/E all items noted, action taken, and progress of control device installation. The last inspection and balancing shall be performed in the presence of a professional engineer active in the design of mechanical building systems.

END OF SECTION 230593
SECTION 233113 – METAL DUCTS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Double-wall rectangular ducts and fittings.
   4. Sheet metal materials.
   5. Sealants and gaskets.
   6. Hangers and supports.

1.3. PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4. SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.
F. Field quality-control reports.

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. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct allowing for insulation if lined.

2.2. SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.
   f. Norlock Metal Products, Inc.

B. 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.

C. Longitudinal Seams: Select seam types and fabricate according to 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."
   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.

D. 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."

2.3. ELBOW CONFIGURATION:

A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
   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."

B. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

1. 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.
   a. Radius-to Diameter Ratio: 1.5.

2. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

3. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

2.4. BRANCH CONFIGURATION:

A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

1. Rectangular Main to Rectangular Branch: 45-degree entry.

2. Rectangular Main to Round Branch: High Efficiency 45 degree takeoff.

B. 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.

1. Velocity 1000 fpm or Lower: 90-degree tap.

2. Velocity 1000 to 1500 fpm: Conical tap.

3. Velocity 1500 fpm or Higher: 45-degree lateral.

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, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.


2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.


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 1 mil 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 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

2.6. SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Sealant: Modified styrene acrylic.

3. Indoor and outdoor, Water resistant, Mold and mildew resistant.
4. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
   5. VOC: Maximum 75 g/L (less water).
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

D. Solvent-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Base: Synthetic rubber resin.
   3. Solids Content: Minimum 60 percent.
   4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
   5. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

E. Flanged Joint Sealant: Comply with ASTM C 920.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

H. Pressure sensitive duct joint sealer:

2.7. HANGERS AND SUPPORTS

A. Indicate the extent of corrosive environment on Drawings.
B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
D. Strap and Rod Sizes: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, “Rectangular Duct Hangers Minimum Size,” and Table 4-2, “Minimum Hanger Sizes for Round Duct.”
E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
I. Trapeze and Riser Supports:
   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. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
B. Install ducts according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
C. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1" or 2" in height and width of ductwork as required to accommodate insulation thickness. Mount specialties such as turning vanes, dampers, etc., to ductwork with that section insulated “Build Outs” to maintain continuity of thermal barrier.

D. All ductwork within 15 feet of connection to rooftop units shall be constructed to 6" WG class regardless of unit static pressure ratings and be a minimum of 18 gauge sheet metal. Roof deck shall only be cut out as required for ductwork penetrations and annular gap around duct shall be sealed with elastomeric caulk to reduce rooftop unit breakout noise.

E. Install round and flat-oval ducts in maximum practical lengths.

F. Install ducts with fewest possible joints.

G. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

H. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

M. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section “Air Duct Accessories” for fire and smoke dampers.

N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA’s “Duct Cleanliness for New Construction Guidelines.”

3.2. DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in “Duct Schedule” Article according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible.”

B. Seal ducts to the scheduled seal classes according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible”:

C. In residential occupancies duct tightness shall be verified by either of the following:

1. Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. All register boots shall be taped or otherwise sealed during the test.

2. Rough-in test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3 cfm (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

3. Exception: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

3.3. HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Chapter 4, “Hangers and Supports.”

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Table 4-1, "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.
D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4. CONNECTIONS
A. Coordinate duct installations and specialty arrangements with Drawings.
B. Make connections to equipment with flexible connectors complying with Division 23 Section “Air Duct Accessories.”
C. Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible” for branch, outlet and inlet, and terminal unit connections.

3.5. PAINTING
A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.6. FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Leakage Tests:
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days’ advance notice for testing.
C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to “Vacuum Test” in NADCA ACR, “Assessment, Cleaning and Restoration of HVAC Systems.”
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
   3. Duct system will be considered defective if it does not pass tests and inspections.
   4. Prepare test and inspection reports.

3.7. START UP
A. Air Balance: Comply with requirements in Division 23 Section “Testing, Adjusting, and Balancing for HVAC.”

3.8. DUCT SCHEDULE
A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

| SYSTEM  | Material | Pressure Class | Min. SMACNA Seal Class | Leakage Class |
|---------|----------|----------------|------------------------|--------------|-------------|
| Supply  |          |                |                        |              |             |

233113-6
METAL DUCTS
<table>
<thead>
<tr>
<th>Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units</th>
<th>Galv. SM</th>
<th>2&quot; Pos.</th>
<th>C</th>
<th>Round-3 Rect-6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Return</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units</td>
<td>Galv. SM</td>
<td>2&quot; Neg.</td>
<td>C</td>
<td>Round-3 Rect-6</td>
</tr>
<tr>
<td><strong>Exhaust</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ducts Connected to General Exhaust</td>
<td>Galv. SM</td>
<td>2&quot; Pos. or Neg.</td>
<td>B</td>
<td>Round-3 Rect-6</td>
</tr>
<tr>
<td><strong>Outside Air</strong></td>
<td></td>
<td></td>
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<tr>
<td>Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units</td>
<td>Galv. SM</td>
<td>2&quot; Neg.</td>
<td>C</td>
<td>Round-3 Rect-6</td>
</tr>
</tbody>
</table>

**END OF SECTION 233113**
SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
   a. Special fittings.
   c. Control damper installations.
   d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
   e. Wiring Diagrams: For power, signal, and control wiring.
2. Operation and maintenance data.
C. QUALITY ASSURANCE
2. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS

2.1. MATERIALS
A. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.
C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2. BACKDRAFT AND PRESSURE RELIEF DAMPERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.
2. Cesco Products.
3. Duro Dyne Inc.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorf; a division of PCI Industries, Inc.
8. Ruskin Company.
9. SEMCO Incorporated.
B. Description: Gravity balanced.
C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.
E. Blade Action: Parallel.
F. Blade Seals: Neoprene, mechanically locked.
G. Blade Axles: Nonferrous metal.
H. Tie Bars and Brackets: Galvanized steel.
I. Return Spring: Adjustable tension.
J. Bearings: Steel ball or synthetic pivot bushings.
K. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Retain one of first two subparagraphs below.
      a. Sleeve Thickness: 20-gage minimum.
      b. Sleeve Length: 6 inches minimum.
M. 90-degree stops.

2.3. MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Air Balance Inc.
      b. Flexmaster U.S.A., Inc.
      c. McGill AirFlow LLC.
      d. METALAIRE, Inc.
      e. Nailor Industries Inc.
      f. Pottorff; a division of PCI Industries, Inc.
      g. Ruskin Company.
      h. Trox USA Inc.
      i. Vent Products Company, Inc.
   2. Suitable for horizontal or vertical applications.
   3. Frames: Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness. Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
   4. Blades: Multiple or single blade. Parallel blade design for mixing applications and opposed-blade design for balance only applications. Stiffen damper blades for stability. Galvanized-steel, 0.064 inch thick.
   6. Bearings: Molded synthetic. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.
2.4. **CONTROL DAMPERS**

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

1. Cesco Products.
2. Duro Dyne Inc.
3. Flexmaster U.S.A., Inc.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
11. Young Regulator Company.

B. Frames: Hat shaped. Galvanized-steel channels, 0.064 inch thick. Mitered and welded corners.

C. Blades: Multiple blade with maximum blade width of 8 inches. Parallel-blade design when used at junctions of differing air temperatures and opposed-blade design otherwise. Galvanized steel. 0.064 inch thick. Closed-cell neoprene edging for low leakage applications.

D. Blade Axles: 1/2-inch diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

E. Bearings: Molded synthetic. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft. Thrust bearings at each end of every blade.

2.5. **TURNING VANES**

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.6. **FLEXIBLE CONNECTORS**

A. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain first paragraph and list of manufacturers below. See Division 01 Section "Product Requirements."

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.


2.7. **LOW PRESSURE FLEXIBLE DUCTS**

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

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Thermoflex

B. Low Pressure Flexible Duct
1. Thermoflex M-KE rated for +6" W.G. max. and -1" W.G. max. for duct sizes 4" to 14", +6" W.G. max. and -0.5" W.G. max for duct sizes 14" to 16", +4" W.G. max. and -0.5" W.G. max for duct sizes 18" to 20". Rated for 3500 FPM maximum velocity. UL listed "UL-181 Standards Class I Duct Material" complying with NFPA Standards 90A and 90B. Duct shall be composed of an acoustically rated inner polymeric liner duct bonded to coated steel wire helix. Fiberglass insulation and tear resistant metalized polyester film outer vapor barrier. Maximum flexible duct length or run shall be 5'-0" unless otherwise noted. Flexible ductwork shall be securely attached to both the rigid duct connection and diffuser neck with plastic band clamps or stainless steel worm driven clamps. Equivalent by Wiremold, Cleavaflex, Flexmaster.

2.8. DUCT ACCESSORY HARDWARE
A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION
3.1. INSTALLATION
A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
E. Set dampers to fully open position before testing, adjusting, and balancing.
F. Install test holes at fan inlets and outlets and elsewhere as indicated.
G. Install fire and smoke dampers according to UL listing.
H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.
I. Install access doors with swing against duct static pressure.
J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.

K. Install flexible connectors to connect ducts to equipment.
L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
M. Retain first paragraph below to allow use of flexible duct to connect terminal units to metal duct.
N. Connect terminal units to supply ducts directly with maximum 12-inch lengths of high pressure flexible duct. Do not use flexible ducts to change directions.
O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
P. Connect flexible ducts to metal ducts with draw bands.
Q. Install duct test holes where required for testing and balancing purposes.

3.2. FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300
SECTION 233423 – EXHAUST FANS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
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.
C. Field quality-control test reports.
D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. CEILING AND CABINET EXHAUST FANS

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:
   2. Carnes Company HVAC.
   4. Loren Cook Company.
   5. NuTone Inc.
   6. Panasonic.
   7. Penn Ventilation.
B. Motor and drives shall be isolated from the exhaust airstream. Air for cooling the motor shall be supplied to the internal motor compartment through a vent tube from a location free from discharge contaminants. Motors shall be readily accessible for maintenance. The wheel shaft shall be ground, polished, coated with a rust inhibitive finish and mounted in heavy duty, permanently sealed pillow block ball bearings which are capable of 200,000 hours of life, average operation. The drives shall be sized at a minimum of 165% of driven horsepower. Drive belts shall be oil-resistant, non-static and be capable of 25,000 hours of life, average operation. Sheaves shall be fully machined cast iron or pressed steel, keyed and securely attached to the shafts. Variable pitch motor sheaves shall be standard.
C. Propeller exhaust fans shall be of the belt drive type as scheduled. Fans shall be dynamically balanced to assure quiet and vibration free operation.
D. Provide where shown on plans exhaust fans as hereinafter specified. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance. Reference the exhaust fan schedule on plans.
E. Provide exhaust fans with speed controls to be furnished to the electrical contractor for mounting at the fan.

PART 3 EXECUTION

3.1. INSTALLATION

1. Install power ventilators level and plumb.
2. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
3. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
4. Support suspended units from structure using threaded steel rods and spring hangers. Vibration-control devices are specified in SECTION 230548 – MECHANICAL SOUND AND VIBRATION CONTROL
5. In seismic zones, restrain support units.
6. Install units with clearances for service and maintenance.
7. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

B. CONNECTIONS

1. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible
EXHAUST FANS

connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
2. Install ducts adjacent to power ventilators to allow service and maintenance.
3. Ground equipment.
4. 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.
5. Interlock operation of fans to associated backdraft and control dampers.

C. FIELD QUALITY CONTROL

1. Equipment Startup Checks:
   a. Verify that shipping, blocking, and bracing are removed.
   b. 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.
   c. Verify that cleaning and adjusting are complete.
   d. 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.
   e. Verify lubrication for bearings and other moving parts.
   f. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   g. Disable automatic temperature-control operators.

2. Starting Procedures:
   a. Energize motor and adjust fan to indicated rpm.
   b. Measure and record motor voltage and amperage.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Shut unit down and reconnect automatic temperature-control operators.
6. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
7. Replace fan and motor pulleys as required to achieve design airflow.
8. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

D. ADJUSTING

1. Adjust damper linkages for proper damper operation.
2. Adjust belt tension.
3. Lubricate bearings.

E. CLEANING

1. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
2. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

F. DEMONSTRATION

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 233423
SECTION 233700 – DUCT INSULATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.

2. Insulating cements.

3. Adhesives.


5. Sealants.

6. Factory-applied jackets.

7. Field-applied jackets.

8. Tapes.

1.3. SUBMITTALS

1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

B. QUALITY ASSURANCE

1. 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, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4. DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5. COORDINATION

A. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 PRODUCTS

2.1. INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. 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.
C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2. DUCT LINER

A. Fibrous-Glass Duct Liner (Flat Applications): Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fiberglass 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.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Fibrous-Glass Duct Liner (Round Applications): Engineered, pre-formed insulation designed for specific duct diameters and fittings. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fiberglass Duct Liner Standard." Rigid, resin bonded fiberglass glass board with a damage-resistant, flame retardant veil faced airstream surface with a reinforced aluminum foil (FRK) backing.

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.
   i. Maximum Thermal Conductivity:
      • Type I, Flexible: 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.

C. Fiber-Free Duct Liner (Flat Applications): Polyester blanket insulation with FSK facing. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ductmate.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

4. Duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing. Liner must have a noise reduction coefficient of at least 0.65 and have thermal values greater or equal to an R-4.2 at 1", R-5 at 1.25", R-6 at 1 Y", and R-8 at 2" respectively.

5. Polyester liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute, and contain zero VOCs per ASTM D 5116. Liner must comply with all applicable standards including ASTM E84, ASTM C518, ASTM G-21, NFPA 90A and 90B, and UL 181.

6. Polyester duct liner must be attached using a non-flammable, low VOC water based adhesive. When
applicable, apply a non-flammable, low voe water based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HV AC Duct Liner installation instructions. Liner must consist of at least 25% recycled content.


D. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA Inc.
   b. Armacell LLC.
   c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.3. DUCT WRAP

A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. 1.0 lb. density standard duct insulation type IV with foil-scram-craft facing and .27 BTUH thermal conductivity at 75 degrees mean temperature.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; All-Service Duct Wrap.

B. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

C. Flexible Elastomeric Duct Wrap: Closed cell insulation with a 16 mil laminated covering membrane (a UV protective white or silver, blended polymeric top surface and a puncture-resistant blended polymeric base, around a scrim reinforced core). The membrane has a 10-year limited warranty against breakdown due to UV radiation. Mold-resistant flexible elastomeric thermal insulation. It is manufactured without the use of CFCs, HFCs or HCFCs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armacell LLC ArmaTuff Plus II.

2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied
FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

2.4. INSULATING CEMENTS
   A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5. 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.
      1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
         B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
         D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.6. MASTICS
   A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
   B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
      1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
      2. Service Temperature Range: Minus 20 to plus 180 deg F.
   C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
      1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
      2. Service Temperature Range: Minus 20 to plus 200 deg F.
      3. Solids Content: 63 percent by volume and 73 percent by weight.

2.7. SEALANTS
   A. Joint Sealants:
      1. Materials shall be compatible with insulation materials, jackets, and substrates.
      2. Permanently flexible, elastomeric sealant.
      3. Service Temperature Range: Minus 100 to plus 300 deg F.
      5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   B. FSK and Metal Jacket Flashing Sealants:
      1. Materials shall be compatible with insulation materials, jackets, and substrates.
      2. Fire- and water-resistant, flexible, elastomeric sealant.
      3. Service Temperature Range: Minus 40 to plus 250 deg F.
      5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2.8. FACTORY-APPLIED JACKETS
A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9. FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
   1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
   2. Factory cut and rolled to size.
   3. Finish and thickness are indicated in field-applied jacket schedules.
   5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   6. Factory-Fabricated Fitting Covers:
      a. Same material, finish, and thickness as jacket.
      b. End caps.
      c. Beveled collars.
      d. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10. TAPES
A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 6.5 mils.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

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.
B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3. INSULATION SCHEDULE
A. Refer to drawings for insulation and ductwork schedule.
3.4. GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   4. For below ambient services, apply vapor-barrier mastic over staples.
   5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   4. Access doors.

P. Undamaged insulation systems on cold surface ductwork and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

Q. 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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. 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.
8. 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.
9. For double wall ductwork, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.5. PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Penetration Firestopping and fire-resistant joint sealers.
C. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping."

3.6. MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer’s recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
B. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching
staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier
mastic, and sealant at joints, seams, and protrusions.

1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
2. 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.

C. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure
   with steel bands spaced a maximum of 18 inches o.c.
D. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.
   Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
E. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips
   of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins
   spaced 6 inches o.c.
F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent
      coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-
      weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline
         of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way,
         and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly
         against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation
         surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor
   barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches
   from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch
   outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket,
   adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals.
      Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation
      face, along butt end of insulation, and over the surface. Cover insulation face and surface to
      be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each
   surface. Groove and score insulation to fit as closely as possible to outside and inside radius of
   elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit
   the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide
   strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and
   flange with pins spaced 6 inches o.c.

3.7. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION
   A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in
      insulation that allow passage of air to surface being insulated.
3.8. EXTERIOR FLEXIBLE ELASTOMERIC INSULATION INSTALLATION
   A. install using manufacturer recommended adhesives or with pre-applied pressure sensitive adhesive (PSA) for
      application to large, flat or curved metal surfaces such as ducts, vessels, very large pipes or tanks.
   B. The seams must be installed in compression and sealed with adhesives. Adhesives are contact adhesives
      and shall be applied to duct and insulation surfaces.
C. Cover seams with manufactured Seal Tape specific for application matching jacket.
D. Exterior duct work must be pitched to allow rain water to run off the insulation.
E. Do not install below ground.
F. The application temperature should be above 40°F (+4°C) and 100°F (+38°C).

3.9. FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer’s recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10. 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 Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

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.

3.11. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
   1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
   2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

3.12. FIELD QUALITY ASSURANCE

A. Upon completion of insulation work and before operation is to commence, visually inspect the work and verify that it has been correctly installed.
B. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct
system. Allow for a means of removal of such material.
C. Check the duct system to ensure that there are no air leaks through joints.

3.13. PROTECTION
A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with duct liner damage and moisture-saturated insulation.
B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

END OF SECTION 233700
SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1. RELATED DOCUMENTS

A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1. GRILLES, REGISTERS AND DIFFUSERS

A. Provide units by Titus, E.H. Price, Metal-Aire, Tuttle & Bailey, Krueger
B. Provide product data for each type of product indicated, include the following: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings. Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
C. Submit information showing ceiling suspension assembly members, method of attaching hangers to building structure, size and location of initial access modules for acoustical tile. ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings. Duct access panels.
D. Unless noted otherwise finish shall be off white when mounted in ceiling, prime coat when mounted on wall finish.
E. SPECIAL APPLICATION DIFFUSERS
   1. LAMINAR FLOW DIFFUSERS
      a. Diffusers shall be constructed using a 6” tall, maximum, back pan which is designed for optimum performance with the diffuser. The back pan shall have integral hanger tabs for securing the unit to the overhead structure to prevent falling in case of earthquakes or other ceiling damage. Each unit shall have an integral internal baffle for evenly distributing air over the entire face of the diffuser. Each unit shall have an integral volume damper accessible through the face of the diffuser. The face of the diffuser shall be constructed of .040” thick aluminum and shall be perforated with 3/32” diagram holes on 1/4” centers. The free area of the face shall be 13%. The face shall be secured in place by 1/4” turn fasteners for quick removal and sanitizing. Each unit must have a removable center plug for adjusting the damper.

PART 3 EXECUTION

A. Provide where shown on plans grilles, registers, and diffusers. Set all units with rubber gaskets for air tight connection with mounting surface, see drawings for types, sizes, air flow and quantity. Refer to schedule on plans. Install diffusers, registers, and grilles level and plumb.
B. Install all registers with curve of louver away from line of sight. Unless noted otherwise, provide duct mounted diffusers and registers with standard margins.
C. Provide proper mounting supplies and arrangements for areas shown. Check Architectural drawings for ceiling and all construction. 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. Proceed with installation only after unsatisfactory conditions have been corrected.
D. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

F. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713
SECTION 233719 – HVAC LOUVERS

PART 1 GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 230500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. PERFORMANCE REQUIREMENTS
A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer’s stock units identical to those provided, except for length and width according to AMCA 500-L.

1.3. SUBMITTALS
A. Product Data: For each type of product indicated.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
C. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 PRODUCT

2.1. LOUVERS
A. Equivalent by Ruskin, Louvers and Dampers, Greenheck, American Warming and Ventilating, Industrial Louvers, ACME.
B. Louvers shall be Ruskin Model ELF375DXH extruded 6063T5 aluminum alloy construction as follows: 4” deep frame, 0.125” wall thickness. 0.125” wall thickness blades, Drainable blades are positioned at 37-1/2° angle and spaced approximately 53/32” center to center. Screen: 3/4” x .051” expanded, flattened aluminum in removable frame. Provide in custom Kynar finish as selected by Architect. AMCA Certified.
C. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 54% free area based on a 48” wide x 48” high size. Stationary drainable blades shall be contained within a 4” frame. Louver components (heads, jambs, sills, blades, & mullions) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 10 feet and shall incorporate structural supports required to withstand a windload of 20 lbs. per sq. ft. (equivalent of a 90 mph wind).
D. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
E. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
F. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
G. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
H. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

END OF SECTION 233719
SECTION 238100 – FURNACES, EVAPORATORS AND CONDENSING UNITS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 230500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
   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.
   C. Field quality-control test reports.
   D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL
   A. Provide as scheduled and indicated on plans furnaces, evaporators, and condensing units as hereinafter specified.
   B. Equivalents by Trane, Lennox, York or Carrier.

2.2. UNITS
   A. HIGH EFFICIENCY CONDENSING FURNACES
      1. Provide 90% efficient upflow, natural gas heating furnace certified by American Gas Association. Electronic spark ignition, dual solenoid combination gas valve and regulator, aluminized steel heat exchanger, single port non-linting burners, auto temperature on-temperature off adjustable fan unit control, multi-speed direct drive, blower motor, blower door safety switch to terminate furnace operation when blower door is removed, heavy gauge steel cabinet construction with baked-on enamel finish insulated with foil faced fiberglass insulation. Provide 2” or 3” plastic C/A and flue piping complete with concentric roof termination kits. Insulate flue piping. Units shall have a manufacturer’s designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.
      2. Provide Farr 20/20 or equal pleated disposable air filters in sizes as specified. Mount filter in slide rack with hinged door and latch in return duct work.
   B. DIRECT EXPANSION EVAPORATOR COILS
      1. Provide blow-thru coil module consisting of fully insulated metal casing with drain pan and duct flanges. Coil shall have copper tubes with aluminum fins. Provide thermostatic expansion valve.
   C. CONDENSING UNITS
      1. UNIT
         a. Provide condensing unit with heavy gauge integral steel base, hermetic compressor, condenser coil, and motor. Rated SEER shall not be less than 13. Provide one year parts and labor warranty on the entire system and an additional 4 year compressor only warranty. Mount units on 3½” reinforced concrete pads a minimum of 6” larger in each dimension.
         b. Unit frame shall be one-piece welded of 18-gauge zinc coated galvanized steel, baked-on enamel finish.
         c. Compressor shall be hermetic, scroll, crankcase heater and well ring type suction and discharge valves rubber-in-shear isolators. Refrigerant shall be R-410a. Unit shall have anti-short cycle prevention controls.
         d. Motor shall be suction gas-cooled, internal motor overloads.
         e. Condenser fan shall be vertical discharge with direct drive motor, statically and dynamically balanced, aluminum blades, zinc ball bearings, built-in motor overloads.
         f. Coil shall be aluminum fin mechanically bonded to seamless copper tubing. Factory leak tested at 425 psig.
         g. Provide louvered coil hail guards to alleviate coil damage.
         h. Provide low ambient accessories to allow operation to 30 degrees F. and defrost controls.
PART 3 EXECUTION

3.1. FURNACE INSTALLATION

A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
B. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
C. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
D. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
E. Identify furnaces according to Division 23 Section Mechanical Identification.
F. Manufacturer to final size all refrigerant suction and liquid lines. Provide all accumulators, solenoid valve and any other components as required for refrigerant line lengths indicated by drawings. Provide all refrigerant and oil required for each refrigerant circuit.
G. Mount units on 3½” reinforced concrete pads a minimum of 6” larger in each dimension.

3.2. FURNACE CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect gas piping according to Division 22 Sections for Fuel Gas Piping.
C. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to noncondensing furnace vent connection and extend outdoors. Type B vents and their installation requirements are specified in Division 23 Section "Breechings, Chimneys, and Stacks."
D. Vent and Outside-Air Connection, Condensing, Gas-Fired Furnaces: Connect plastic piping vent material to furnace connections and extend outdoors. Terminate vent outdoors with a cap and in an arrangement that will protect against entry of birds, insects, and dirt.
E. Plastic pipe joint construction is specified in Division 23 Section "Basic Mechanical Materials and Methods."
F. Connect ducts according to Division 23 Section Ductwork.
G. Install piping adjacent to machine to allow service and maintenance.
H. Ground equipment according to Division 26 Section "Grounding and Bonding."
I. 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.
J. Connect and wire any outside air dampers and interlock with furnace operation. Install all electrical in accordance with Division 26. Provide all necessary relays, interlocks and circuiting to open outside air dampers during operation of unit fan.
K. Connect condensate drain pans. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

3.3. FURNACE ADJUSTING

A. Adjust initial temperature and humidity set points.
B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.4. FURNACE CLEANING

A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
B. Install new filters in each furnace within 14 days after Substantial Completion.

3.5. CONDENSING UNIT INSTALLATION

A. Install condensing units according to manufacturer's written instructions.
B. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
C. Install ground-mounted units on 4-inch-thick, reinforced concrete base, 4 inches larger than condensing unit on each side. Concrete, reinforcement, and formwork requirements are specified in Division 3. Coordinate installation of anchoring devices.
D. Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.
E. Install units on spring isolators specified in Division 23 Section "Mechanical Vibration Controls and Seismic Restraints."
3.6. CONDENSING UNIT CONNECTIONS

A. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
B. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories.
C. Ground equipment.
D. 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 486A and UL 486B.

3.7. CONDENSING UNIT FIELD QUALITY CONTROL

A. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.
B. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Remove and replace malfunctioning units with new units and retest.

3.8. CONDENSING UNIT CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.

3.9. COMMISSIONING

A. Verify that units are installed and connected according to the Contract Documents.
B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
C. Inspect for physical damage to unit casing.
D. Verify that access doors move freely and are weathertight.
E. Clean units and inspect for construction debris.
F. Check that all bolts and screws are tight.
G. Adjust vibration isolation and flexible connections.
H. Verify that controls are connected and operational.
I. Lubricate bearings on fans.
J. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
K. Adjust fan belts to proper alignment and tension.
L. Start unit according to manufacturer's written instructions.
M. Complete manufacturer's starting checklist.
N. Measure and record airflow over coils.
O. Check operation of condenser capacity control device.
P. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
Q. After startup and performance test, lubricate bearings and adjust belt tension.

3.10. CONDENSING UNIT DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   2. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 238100
SECTION 238102 – PROGRAMMABLE THERMOSTATS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 230500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
   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.
   C. Field quality-control test reports.
   D. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL
   A. Provide Thermostats by Honeywell, Johnson Controls, White-Rogers, Trane, Carrier or approved equal.

2.2. UNITS
   A. Provide programmable thermostats with stages of cooling and heating as required by stages of cooling and heating on specified equipment (Refer to drawings and other portions of this specification to determine exact control required.)
   B. Thermostat shall have the following:
      1. Seven (7) day programming capability with 2 occupied/unoccupied periods per day.
      2. Automatic heat/cool change over.
      3. Start time optimization
      4. Continuous fan operation in occupied mode.
      5. Intermittent fan operation in unoccupied mode.
      6. Battery backup
      7. Temporary override capability
      8. Locking setpoints to prevent tampering.
      9. Anti-recycle controls
   C. Provide with all subbases required and interfaces to other equipment as required.

PART 3 EXECUTION

3.1. INSTALLATION
   A. Coordinate with Electrical Contractor to provide all wiring between condensing units, furnaces, thermostats and all other required controls.
   B. Obtain a desired operational schedule from the owner or tenant and program each thermostat with desired settings.
   C. Provide Thermostats by Honeywell, Johnson Controls, White-Rogers, Trane, Carrier or approved equal.

END OF SECTION 238102
SECTION 238130 – MINI-SPLIT SYSTEMS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 230500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 PRODUCTS

2.1. GENERAL
   A. MANUFACTURERS:
      1. Approved equivalent manufacturers: Daikin, Mitsubishi, LG
   B. QUALITY ASSURANCE
      1. The units shall be listed by Electrical Laboratories (ETL) and bear the cETL label.
      2. All wiring shall be in accordance with the National Electric Code (NEC).
      3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
      4. The outdoor unit will be factory charged with R-410A.
   C. DELIVERY, STORAGE AND HANDLING
      1. Unit shall be stored and handled according to the manufacturer's recommendations.
   D. WARRANTY
      1. The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The units shall have a limited labor warranty for a period of one (1) year from date of installation. The compressors shall have a warranty of six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at factory by trained service professional.
   E. SHOP DRAWING / SUBMITTAL
      1. The manufacturer shall produce full shop drawings showing the complete design and layout of the system that includes the piping, fittings, controls, equipment and accessories for a complete two or three pipe heat recovery air conditioning system.

2.2. UNITS
   A. GENERAL
      1. REQUIREMENTS
         a. Units shall be operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation within a conditioned space. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with remote control. A mold-resistant, resin net air filter shall be included as standard equipment.
         b. Indoor units shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
         c. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
         d. Both refrigerant lines shall be insulated from the outdoor unit.
         e. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21” of lift.
         f. The indoor units shall be equipped with a return air thermistor.
         g. The voltage range will be 253 volts maximum and 187 volts minimum.
      2. Fan: The fan shall be statically and dynamically balanced impeller with high and low fan speeds.
The airflow rate shall be available in high and low settings. The fan motor shall be thermally protected.

3. **Coil:**
   a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   c. The coil shall be a 2 or 3-row cross fin copper evaporator coil with design completely factory tested.
   d. The refrigerant connections shall be flare connections.
   e. A condensate pan shall be located under the coil.
   f. A condensate pump shall be located below the coil in the condensate pan with a built in safety alarm.
   g. A thermistor will be located on the liquid and gas line.

4. **Filter:** The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

5. **Electrical:** A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

6. **Control:** The unit shall have controls provided by manufacturer to perform input functions necessary to operate the system. The unit shall be compatible with interfacing with connection to LonWorks networks or interfacing with connection to BMS system. Consult with manufacturer prior to applying controls and provide all necessary interface materials and labor.

**B. 4 WAY CEILING CASSETTE UNIT**

1. **General:** Indoor unit shall be a ceiling cassette fan coil unit for installation into the ceiling cavity equipped with an air panel grill. It shall be available from 7,500 Btu/h to 36,000 Btu/h. It shall be a four-way air distribution type, ivory white, impact resistant with a washable decoration panel.

2. **Indoor Unit:**
   a. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
   b. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
   c. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21” of lift.

3. **Unit Cabinet:**
   a. The cabinet shall be space saving and shall be located into the ceiling.
   b. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
   c. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
   d. Fresh air intake shall be possible by way of optional fresh air intake kit.
   e. A branch duct knockout shall exist for branch ducting supply air.
   f. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
   g. Optional high efficiency air filters are available for each model unit.

4. **Fan:** The fan shall be direct-drive turbo fan type.

5. **Filter:** Optional high efficiency filters shall be available.

6. **Accessories:** Fresh air intake and supply air duct connections. Remote “in-room” sensor kit.

**2.3. OUTDOOR UNIT**

**A. General**

1. The outdoor unit is designed specifically for use with series components.

2. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
a. High/low pressure gas line, liquid and suction lines must be individually insulated between the outdoor and indoor units.

3. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

4. The unit shall incorporate an auto-charging feature and a refrigerant charge check function.

5. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

6. The outdoor unit shall be capable of heating operation at 0°F dry bulb ambient temperature without additional low ambient controls.

7. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

B. Unit Cabinet:

1. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

2. The outdoor unit shall have factory installed hail guards or field installed Permatron model # Hailguard 54 black polypropylene netting.

C. Fan: The condensing unit shall consist of one or more propeller type, direct-drive 350 and 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.

2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.

3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.

4. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1.

5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

E. Compressor:

1. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G-type” with a maximum speed of 7,980 rpm.

2. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

3. The capacity control range shall be as low as 6% to 100%.

4. Each non-inverter compressor shall also be of the hermetically sealed scroll type.

5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

6. Oil separators shall be standard with the equipment together with an intelligent oil management system.

7. The compressor shall be spring mounted to avoid the transmission of vibration.

8. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours.

F. Electrical:

1. The control voltage between the indoor and outdoor unit shall be 16VDC non-shielded, stranded 2 conductor cable.

PART 3 EXECUTION
3.1. COORDINATION

A. Provide approved submittals to other parties or verify G/C has provided record submittals for use in coordination of connections between other trades well in advance to coordinate other submittals and construction rough-ins.
3.2. UNIT INSTALLATION
   A. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
   B. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
   C. Identify according to Division 23 Section Mechanical Identification.
   D. Manufacturer to final size all refrigerant lines. Provide all valves, fittings and any other components as required for refrigerant line lengths indicated by drawings. Provide all refrigerant and oil required for each refrigerant circuit.

3.3. AIR HANDLER CONNECTIONS
   A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
   B. Connect condensate drain pans. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
   C. Connect ducts according to Division 23 Section Ductwork.
   D. Install piping adjacent to machine to allow service and maintenance.
   E. Ground equipment according to Division 26 Section "Grounding and Bonding."
   F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4. AIR HANDLER ADJUSTING
   A. Adjust initial temperature and humidity set points.
   B. Set controls, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.5. SYSTEM AND EQUIPMENT IDENTIFICATION
   A. Provide engraved equipment labels for all pieces of equipment including indoor units and outdoor units.

3.6. COMMISSIONING
   A. Verify that units are installed and connected according to the Contract Documents.
   B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   C. Inspect for physical damage to unit casing.
   D. Verify that access doors move freely and are weathertight.
   E. Clean units and inspect for construction debris.
   F. Check that all bolts and screws are tight.
   G. Adjust vibration isolation and flexible connections.
   H. Verify that controls are connected and operational.
   I. Lubricate bearings on fans.
   J. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
   K. Adjust fan belts to proper alignment and tension.
   L. Start unit according to manufacturer's written instructions.
   M. Complete manufacturer's starting checklist.
   N. Measure and record airflow over coils.
   O. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
   P. After startup and performance test lubricate bearings.

3.7. UNIT DEMONSTRATION
   A. Startup Services: Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

3.8. AIR HANDLER CLEANING
   A. After completing installation, clean units internally according to manufacturer's written instructions.
   B. Install new filters in each unit within 14 days after Substantial Completion.
3.9. COORDINATION
A. Provide approved submittals to other parties or verify G/C has provided record submittals for use in coordination of connections between other trades well in advance to coordinate other submittals and construction rough-ins.
B. Review other trades submittals for coordination of connections and related installation clearances, appurtenances and related equipment.
C. Conduct coordination meeting with all related trades prior to installation of equipment. Bring all apparent conflicts to the attention of the Architect/Engineer.

3.10. CONDENSING UNIT INSTALLATION
A. Install condensing units according to manufacturer’s written instructions.
B. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer’s recommended clearances.
C. Install ground-mounted units on 4-inch-thick, reinforced concrete base, 4 inches larger than condensing unit on each side. Coordinate installation of anchoring devices.
D. Install roof-mounted units on manufactured equipment supports. Anchor unit to supports with removable fasteners.
E. Install hailguards on outdoor units. Permatron model # Hailguard 54 black polypropylene netting.
F. Install units on spring isolators specified in Division 23 Section "Mechanical Vibration Controls and Seismic Restraints."

3.11. CONDENSING UNIT CONNECTIONS
A. Connect precharged refrigerant tubing to unit’s quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
B. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories.
C. Ground equipment.
D. 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 486A and UL 486B.

3.12. CONDENSING UNIT FIELD QUALITY CONTROL
A. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.
B. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Remove and replace malfunctioning units with new units and retest.

3.13. CONDENSING UNIT CLEANING
A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.

3.14. CONDENSING COMMISSIONING
SECTION 238239 – ELECTRIC HEATERS

PART 1 GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 230500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
   B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
      1. Plans, elevations, sections, and details.
      2. Location and size of each field connection.
      3. Equipment schedules to include rated capacities, furnished specialties, and accessories.
   C. Field quality-control test reports.
   D. Operation and maintenance data.

1.3. 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 PRODUCTS

2.1. BASEBOARD HEATERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Berko Electric Heating; a division of Marley Engineered Products.
      2. Chromalox, Inc.; a division of Emerson Electric Company.
      3. Indeeco.
      4. Markel Products; a division of TPI Corporation.
      5. Marley Electric Heating; a division of Marley Engineered Products.
      6. QMark Electric Heating; a division of Marley Engineered Products.
      7. Trane.
   B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
   C. Cabinet:
      1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
      2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
      3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
   D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
   F. Fan: Aluminum propeller directly connected to motor.
      1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   G. Controls: Unit-mounted thermostat. Low-voltage relay with transformer kit.
H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install unit heaters to comply with NFPA 90A.
B. Suspend cabinet unit heaters from structure with elastomeric hangers.
C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers.
D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
F. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
G. Ground equipment according to Division 26.
H. Connect wiring according to Division 26.

3.2. 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 238239
END OF DIVISION 230000

END OF DIVISION 230000
BLE OF CONTENTS

SECTION 260500 – ELECTRICAL PROVISIONS
SECTION 260519 – WIRE AND CABLE
SECTION 260520 – BASIC ELECTRICAL MATERIALS AND METHODS
SECTION 260526 – GROUNDING
SECTION 260533 – RACEWAYS AND BOXES
SECTION 260553 – ELECTRICAL IDENTIFICATION
SECTION 260573 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
SECTION 260923 – LIGHTING CONTROL DEVICES
SECTION 262413 – DISTRIBUTION SWITCHBOARD
SECTION 262416 – PANELBOARDS
SECTION 262726 – WIRING DEVICES
SECTION 262813 – FUSES
SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS
SECTION 262913 – ENCLOSED CONTROLLERS
SECTION 265100 – LUMINAIRES, LAMPS AND BALLASTS
SECTION 260500 – ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Electrical Contractor, all sub-contractors, and all material suppliers.

1.2. SCOPE OF WORK
   A. This DIVISION requires the furnishing and installing of complete functioning Electrical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system’s functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
   B. Refer to Architectural, Structural and Mechanical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing conduit in the manner anticipated in the design.

1.3. SPECIFICATION FORM AND DEFINITIONS
   A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, EMAIL admin@pkmreng.com.
   B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
   C. When a word, such as “proper”, “satisfactory”, “equivalent”, and “as directed”, is used, it requires the Architect-Engineer’s review.
   D. “PROVIDE” means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
   E. “INSTALL” means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
   F. “FURNISH” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
   G. “WIRING” means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
   H. “CONDUIT” means the inclusion of all fittings, hangers, supports, sleeves, etc.
   I. “AS DIRECTED” means as directed by the Architect/Engineer, or his representative.
   J. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.4. QUALIFICATIONS
   A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

1.5. LOCAL CONDITIONS
   A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.6. CONTRACT CHANGES
   A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.
1.7. LOCATIONS AND INTERFERENCES

A. Locations of equipment, conduit and other electrical work are indicated diagrammatically by electrical drawings. Layout work from dimensions on Architectural and Structural Drawings. Verify equipment size from manufacturers shop drawings.

B. Study and become familiar with contract drawings of other trades and in particular general construction drawings and details in order to obtain necessary information for figuring installation. Cooperate with other workmen and install work in such a way to avoid interference with their Work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.

C. Any conduit, apparatus, appliance or other electrical item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other Work caused by this contractor, subcontractor, workers or any cause whatsoever, shall be restored as specified for new work.

D. Do not scale electrical drawings for dimensions. Accurately layout work from dimensions indicated on Architectural drawings unless they are found to be in error.

1.8. PERFORMANCE

A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

1.9. WARRANTY

A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor’s expense.

B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10. ALTERNATES

A. Refer to General Requirements for descriptions of any alternates that may be included.

1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

A. The intent of these specifications is to allow ample opportunity for the Contractor to use their ingenuity and abilities to perform the work to their and the Owner’s best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.

B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.

C. In general, these specifications identify required materials and equipment by naming one or more manufacturer’s brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.

D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.

E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.
G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.

H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

1.12. ELECTRONIC PLAN FILES

A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of $50 per sheet, $100 minimum and $25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

1.13. OPENINGS, ACCESS PANELS AND SLEEVES

A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all conduits passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.

B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

1.15. EXTENT OF CONTRACT WORK

A. Provide electrical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of electrical systems. In no case will claims for "Extra Work" be allowed for work about which Electrical Contractor could have been informed before bids were taken.

B. Where specific information for devices, lights or equipment shown on the plans is missing, provide an allowance in the contract amount for furnishing a product reasonably implied by the level of other devices, lights and equipment provided in the contract documents.

C. Electrical Contractor shall be familiar with equipment provided by other Contractors that require electrical connections and control. Follow circuiting shown on drawings for lighting, power and equipment connections.

D. Make required electrical connections to equipment provided under Architectural and Mechanical divisions of this project. Receive and install electric control devices requiring field installation, wiring, and service connection. Equipment supplied by the automatic temperature control contractor shall be installed by the mechanical or automatic temperature control subcontractor. Make required internal field wiring modifications indicated on wiring diagrams of factory installed control systems for control sequence specified. These field modifications shall be limited to jumper connections and connection of internal wiring to alternate terminal block lugs. The cost for field modifications requiring rewiring of factory installed control systems for equipment provided by General or Mechanical Contractors shall be included in base bid of the respective contractor. All temperature control wiring shall be by a licensed electrician under the supervision of temperature control contractor.

E. Check electrical data and wiring diagrams received from Mechanical Contractor of compliance with project voltages, wiring, controls and protective devices shown on electrical drawings. Promptly bring discrepancies found to attention of Architect-Engineer for a decision.

F. Provide safety disconnect switches, contactors, and manual and magnetic motor starters for mechanical and electrical equipment requiring such devices. Omit these devices where included as part of factory installed prewired control systems provided with mechanical equipment. With exception of factory installed devices, provide safety disconnect switches, contacts and motor starters by one manufacturer to allow maximum interchangeability of repair parts and accessories for these devices.

G. To maximum extent possible electrical controls in boiler rooms, equipment rooms, and control rooms shall be grouped in accessible locations and arranged according to function. Where possible use group control panels and combination starters in lieu of individually enclosed devices.
1.16. **CODES, ORDINANCES, RULES AND REGULATIONS**

A. Provide work in accordance with applicable rules, codes, ordinances and regulations of Local, State, Federal Governments, and other authorities having lawful jurisdiction.

B. Conform to latest editions and supplements of following codes, standards or recommended practices.

1.17. **BUILDING CODES:**

A. International Building Codes

1.18. **SAFETY CODES:**


B. Occupational Safety and Health Standard (OSHA) Department of Labor

C. Safety Code for Elevators ANSI A17.1

1.19. **NATIONAL FIRE CODES AND STANDARDS:**

A. NFPA No. 70 National Electrical Code

B. NFPA No. 72 National Fire Alarm and Signaling Code

C. NFPA No. 99 Standard for Health Care Facilities

D. NFPA No. 101 Life Safety Code

E. NFPA No. 110 Standard for Emergency and Standby Power Systems

1.20. **UNDERWRITERS LABORATORIES INC.:**

A. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

1.21. **MISCELLANEOUS CODES:**

A. ANSI A117.1 - Handicapped Accessibility

B. ASHRAE 90.1 2001

C. Americans with Disabilities Act (ADA)

1.22. **STANDARDS**

A. Drawings and specifications indicate minimum construction standard, should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect/Engineer in writing before proceeding with work so that necessary changes can be made. However, if Electrical Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations he shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

1.23. **PERMITS/FEES**

A. Electrical Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect/Engineer with request for final review.

B. Contractor shall include in bid any charges by local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exact which part of the work is to be performed by whom.

**PART 2 - PRODUCTS**

A. Not Used

**PART 3 - EXECUTION**

3.1. **SHOP DRAWINGS**

A. Contractor shall furnish shop drawings of all materials and equipment in an Adobe PDF format.

B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.

C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Mark each submitted item with applicable section and sheet number of these specifications, or plan sheet number when item does not appear in the specifications. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization. Each catalog sheet shall bear the equipment manufacturer’s name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

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D. Contractor shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the Architect-Engineer for their review. All shop drawings submitted to Architect-Engineer shall bear contractor’s approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor’s submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting Contractor’s approval shall be returned to their supplier for re-submittal.

E. No shop drawing submittals will be considered for review by the Architect-Engineer without Contractor’s approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor’s review.

F. The shop drawing submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required. Submittal of all shop drawings as soon as possible before construction starts is preferred. All shop drawings submitted shall contain the following: The project name, the applicable specification section and paragraph, the submittal date, the Contractor’s stamp which shall certify that the stamped drawings have been checked by the Contractor, comply with the drawings and specifications and have been coordinated with other trades. Submittals not so identified will be returned without action for re-submittal.

G. The Architect’s-Engineer’s checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect-Engineer’s attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.

H. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.

I. Shop drawings that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.

J. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Electrical equipment location and conduit coordination shop drawings for conduit fabrication and electrical equipment clearances shall be a minimum of 1/4” scale. Shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work.

L. Architect-Engineer’s review of shop drawings will not relieve Contractor of responsibility for deviations from drawings and specifications unless the Architect-Engineer has specifically approved such deviations in writing, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Architect-Engineer’s review has been obtained. Any time delay caused by correcting and re-submitting shop drawings will be the Contractor’s responsibility.

3.2. SHOP DRAWING COORDINATION

A. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

3.3. SUBMITTALS

A. Contractor shall provide the following submittal sections that apply to this project:

1. WIRING MEANS, METHODS, AND MATERIALS:
   a. Conduits
   b. Conductors and Cables
   c. Outlet Pull and Junction Boxes
   d. Tests and Data

2. WIRING DEVICES AND SPECIALTIES:
   a. Switches
   b. Receptacles
   c. Cover Plates
3. ELECTRICAL DISTRIBUTION:
   a. Switchboards
   b. Panelboards
   c. Fuses
   d. Circuit Breakers
   e. Transformers

4. ELECTRICAL EQUIPMENT
   a. Disconnect Switches
   b. Motor Starters
   c. Motors
   d. Electric Heaters
   e. Photoelectric Controls
   f. Contactors
   g. Time Clocks

5. LUMINAIRES LAMPS AND BALLASTS
   a. Luminaires
   b. Lamps
   c. Ballasts

6. FIRE ALARM SYSTEM
   a. Fire Alarm plans
   b. Fire alarm devices
   c. Voltage Drop Calculations
   d. Battery Calculations

3.4. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)
   A. Submit with shop drawings of equipment, three sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.
   B. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.
   C. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Architect/Engineer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:
      1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
      2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
      3. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
      4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.
      5. Record Set Drawings: The Contractor shall mark up a set of contract documents during construction noting all changes and deviations including change orders. These will be delivered to Architect at end of the project. After the originals are changed to reflect the blue line set, a copy shall be included in the brochure.
      6. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
         a. Project name and address.
         b. Section of work covered by brochure, i.e., Electrical.

3.5. RECORD DOCUMENTS
   A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
   B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
3.6. PREMIUM TIME WORK
   A. The following Work shall be performed at night or weekend other than holiday weekends as directed and
      coordinated with the Owner.
      1. All tie-in, cut-over and modifications to the existing electrical system and other existing system requiring tie-
         ins or modifications shall be arranged and scheduled with the Owner to be done at a time as to maintain
         continuity of the service and not interfere with normal building operations.

3.7. CLEANING UP
   A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of
      his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
   B. Contractor shall clean up all fixtures and equipment at the completion of the project.
   C. All switchboards, panelboards, wireways, trench ducts, cabinets and enclosures shall be thoroughly vacuumed
      clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for
      observation by the Architect/Engineer as required.

3.8. WATERPROOFING
   A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement
      walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves
      or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any
      waterproof membrane, even where such penetration is shown on the Drawings.
   B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the
      waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

3.9. CUTTING AND PATCHING
   A. Contractor shall do cutting and patching of building materials required for installation of work herein specified.
      Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or
      drill through structural members including wall, floors, roofs, and supporting structure, without the Architect’s
      and Structural Engineer’s approval and in a manner approved by them.
   B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work
      will not be permitted.
   C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type,
      quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused
      by installation of electrical work shall be repaired at Contractor’s expense to approval of Architect-Engineer.

3.10. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS
   A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on
      adequate foundations and provide proper anchor bolts and isolation as shown or specified. Level, shim, and
      grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and
      belts according to manufacturer’s instruction. Equipment failures resulting from improper installation or field
      alignment shall be repaired or replaced by Contractor at no cost to Owner.
   B. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor
      fastening in all cases.
   C. Provide electrical floor mounted equipment with 3-1/2” high concrete bases unless shown or specified
      otherwise. Electrical contractor shall size all pads. General contractor shall form all pads, provide and place all
      concrete for said pads. Individual concrete pad shall be no less than 4” wider and 4” longer than equipment,
      and shall extend no less than 2” from each side of equipment.
   D. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with
      suitable structural support, platform or carrier in accordance with best recognized practice. Electrical contractor
      shall arrange for attachment to building structure, unless otherwise indicated on drawings or as specified.
      Provide hangers with vibration eliminators where required. Contractor shall verify that structural members of
      building are adequate to support equipment. Submit details of hangers, platforms and supports together with
      total weights of mounted equipment to Architect/Engineer for review before proceeding with fabrication or
      installation.
   E. Provide 3-1/2” high concrete housekeeping pad as specified above where two or more conduits penetrate floor
      below panelboards.

3.11. START-UP, CHANGEOVER, TRAINING AND OPERATION CHECK
   A. Electrical Contractor shall be responsible for training Owner’s operating personnel to operate and maintain
systems and equipment installed. Keep a record of training provided to Owner’s personnel listing the date, subject covered, instructor’s name, names of Owner’s personnel attending and total hours of instruction given each individual.

B. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the “training” session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.12. FINAL CONSTRUCTION REVIEW
A. At final construction review, Electrical Contractor and the major sub-contractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by Architect/Engineer, that the work complies with purpose and intent of plans and specifications. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 260500
SECTION 260519 – WIRE AND CABLE

PART 1 - GENERAL

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

1.2. SUMMARY
A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.3. SUBMITTALS
A. Product Data: For each type of product indicated.
B. Qualification Data: For testing agency.
C. Field quality-control test reports.

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.

1.5. COORDINATION
A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1. CONDUCTORS AND CABLES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Cable Corporation.
   2. Southwire Company.
B. Copper Conductors: Comply with NEMA WC 70.
C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
   1. Provide consistent color coding of all circuits as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>120/208</th>
<th>277/480</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>B</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>C</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>N</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>Ground</td>
<td>Green w/ White Stripe</td>
<td>Green w/ Yellow Stripe</td>
</tr>
</tbody>
</table>
D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2. CONNECTORS AND SPLICES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.
B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
PART 3 - EXECUTION

3.1. CONDUCTOR MATERIAL APPLICATIONS
A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2. CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
A. Service Entrance: Type THHN-THWN, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway; Metal-clad cable, Type MC.
G. Branch Circuits Concealed in Concrete, Block walls, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
J. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable, concealed in building finishes.
K. Metal Clad (MC) cable installations shall be in accordance with the following:
   1. MC cable used in patient care areas shall be health-care MC cable and the outer sheath shall qualify as an equipment grounding conductor independent of any separate wire-type equipment grounding conductor.
   2. Standard MC cable may be used for non-emergency circuits in other than patient care areas.
   3. MC cable shall not be used for homeruns.
   4. MC cable may be used for light fixture and equipment whips in lengths no longer than 6'-0". The use of MC cable from lighting fixture to lighting fixture shall not be allowed.
   5. MC cable shall not be installed in exposed locations for lighting purposes. MC cable may be exposed in mechanical spaces for equipment whips.

3.3. INSTALLATION OF CONDUCTORS AND CABLES
A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4. CONNECTIONS
A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   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 6 inches of slack.

3.5. FIELD QUALITY CONTROL
A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Test Reports: Prepare a written report to record the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519
SECTION 260520 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1. NEUTRAL AND GROUND WIRES

A. Where individual circuit homeruns (hots, neutral, and ground as part of a single circuit) are indicated on the plans serving lighting and branch circuit receptacle loads, these shall be individual circuits with individual neutrals (no sharing of neutrals and/or grounds).

B. Where shared circuit homeruns (hots, neutral, and ground as part of separate circuits) are indicated on the plans, these shall be allowed to share one (common) ground for three (3) circuits from different phases occurring in one (1) conduit run. When additional circuits occur in conduit run, additional ground wires shall be installed. Conduit shall be upsized and conductors shall be de-rated based on NEC current carrying conductor tables, counting all hots and neutrals as current carrying conductors.

1. No sharing of neutral conductors is allowed in multi-wire branch circuit homeruns, unless the installation meets the requirements of 2014 NEC 210.4(B), and is specifically approved by the engineer of record.

3.2. TESTS RECORDING, REPORTING TESTS AND DATA

A. Record nameplate horsepower, amperes, volts, phase service factor and other necessary data on motors and other electrical equipment furnished and/or connected under this contract.

B. Record motor starter catalog number, size and rating and/or catalog number of thermal-overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specification for instructions for proper sizing of thermal-overload units.

C. Record amperes-per-phase at normal or near-normal loading of each item of equipment furnished and/or connected.

D. Record voltage and ampere-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load.

E. Record correct readings of each feeder conductor after energized and normally loaded, and again after balancing of feeder loads as required by current readings.

F. Record voltage and ampere-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load.

G. Submit at least two (2) typewritten copies of data noted above to Architect-Engineer for review prior to final inspection.

H. Keep a record of all deviations made from routes, locations, circuiting, etc. shown on contract drawings. Prior to final inspection submit one new set of project drawings with all deviations and changes clearly indicated.

3.3. CLEANING AND PAINTING OF MATERIALS AND EQUIPMENT

A. Before energizing switchboards, transformers, panelboards, starters, variable frequency drive and other similar electrical equipment, Contractor shall thoroughly vacuum out all dirt, dust and debris from inside of equipment and shall thoroughly clean outside and inside of equipment.

B. Touch-up painting and refinishing of factory applied finishes shall be by Electrical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.

C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.

D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
E. Where extensive refinishing is required equipment shall be completely repainted.

3.4. **EXCAVATION AND BACKFILL**

A. Perform necessary excavation to receive work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.

B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.

C. Conduct excavations so no walls or footings are disturbed or injured.

D. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by A/E.

E. Mechanically tamp backfill under concrete and pavings in 6” layers to 95% standard density, Reference Division 2.

F. Backfill trenches and excavations to required heights with allowance made for settlement.

G. Tamp fill material thoroughly and moistened as required for specified compaction density.

H. Dispose of excess earth, rubble and debris as directed by Architect.

I. When available, refer to test hole information on architectural drawings or specifications for types of soil to be encountered in excavations.

3.5. **FIRE BARRIERS**

A. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson “Flameseal” fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.

B. Equivalent by Dow, Chemelex, 3M.

C. All holes or voids created by the electrical contractor to extend conduit or wiring through fire rated floors and walls shall be sealed with an intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures of 250 degrees F. It shall have ICBO, BOCAI and SBCCI (NRB 243) approved ratings to 3 hours per ASTM E-814 (UL 1479). Acceptable Material: 3M Fire Barrier Caulk, Putty, Strip and sheet forms.

3.6. **TEMPORARY COVERINGS**

A. Provide temporary covering over all electrical panels, distribution panelboards, outlet boxes and other equipment as required to keep same free from damage due to moisture, plaster, paint, concrete or other foreign materials. Any equipment with finish damaged by moisture, paint, plaster or other foreign materials shall be cleaned and refinished as directed by the Architect without additional cost to the Owner.

B. All temporary openings in conduits shall be covered with metal or plastic caps.

3.7. **PROTECTIVE COVERS**

A. Provide protective wire guards over all wall mounted and ceiling mounted devices subject to damage in areas such as gymnasiums, shops and similar occupancies.

B. Provide lockable covers over thermostats and similar wall mounted devices where items are located in public spaces but should not be operable by the general public.

3.8. **SLEEVES**

A. Provide proper type and size sleeves to General Contractor for electrical ducts, busses, conduits, etc. passing through building construction. Supervise installation to insure proper sleeve location. Unless indicated or approved install no sleeves in structural members.

B. Provide cast iron sleeves extending 1 inch above finished floor where sleeves pass through floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchen. Seal opening between pipe and sleeve with Thunderline Corp. Link Seal.

C. Unless specified otherwise provide 18 gauge galvanized sheet metal sleeves through floors and non-bearing walls. Where piping passes through exterior walls, equipment room walls, air plenum walls and walls between areas that must be isolated from occupied areas, seal space between sleeves and piping, air or water tight are required with Thunderline Corp. Link Seal.

D. Provide O-Z Electrical Manufacturing Co., Inc. Type “FSK” or “WSK” or equivalent thruwall and floor seals where conduits pass through concrete foundation walls below grade.

E. Provide Zurn Z-195 or equivalent flashing sleeve through walls and floors with waterproof membrane. Seal annular space between conduit and sleeve with Thunderline Link Seal or O-Z type CSM sealing bushing.

3.9. **CABLE TRAY**

A. Provide where indicated on plans aluminum cable tray as specified herein.
B. Equivalents by B-Line, Square D, P-W Industries, Inc., Mono-Systems, Thomas and Betts or approved equal.

C. Cable tray shall be aluminum ladder type tray consisting of (2) longitudinal side rails connected by individual cross members. All rung and side rail edges shall be smooth. Cable tray rung spacing shall be 9", tray width shall be 12". Tray loading depth shall be 4 inches. Load capacity of tray shall be a minimum of 66 lbs/ft with a maximum deflection of 1.10 inches at a maximum support span of 12'-0". Tray shall be minimum NEMA Class 12C.

D. Provide required fittings and supports for installation layout as indicated on drawings. Radius of fittings shall be 12 inches. Provide required splice plates, hangers, hold down clips, connectors, endplates and miscellaneous hardware for complete installation.

E. Fire Stopping:

1. Provide reusable heat expanding pillow/bags. Fire stop material must be FM approved and UL classified. Fire seal method must have UL fire rating equal to wall or floor penetrations. The penetration seal must allow future changes such as removal or addition of cables with no damage to the integrity of the seal. The fire stop system shall be UL tested and approved for use with galvanized steel and aluminum cable tray.

2. The seal method must provide immediate seal with no cure time. The penetration seal must be unaffected by atmospheric conditions, water exposure or constant high humidity.

3. The fire seal must be installed in strict accordance with the manufacturer’s published instructions. The material must be free of asbestos and shall not emit any toxic fumes. The containment bag shall be constructed of heavy woven fiberglass. The penetration fire stop system shall be KBS seal bags or approved equal.

4. Alternatively, or as shown on the plans, cable tray shall be stopped short of the fire barrier, and one or more pre-assembled fire-rated pathways shall be used. Pathways shall meet all above requirements for cable tray fire stops.

END OF SECTION 260520
SECTION 260526 – GROUNDING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK
A. Provide grounding electrodes, conductors, connections and equipment to provide a solidly grounded electrical system.

1.3. STANDARDS
A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
   2. ANSI C-1 1978.
   5. NFPA.

1.4. SUBMITTALS
A. Submit test reports certifying resistance values for buried or driven grounds and water pipe grounds.

PART 2 - PRODUCTS

2.1. MATERIALS
A. Ground Cables: green color coded, insulated, annealed stranded tinned copper wire as indicated on Drawings; insulated wire to conform with requirements of Section 16120.
B. Mechanical Connectors: Tin-plated aluminum alloy, UL approved and stamped for use with aluminum or copper conductors.
C. Ground Rods:
   1. Copper-clad steel fabricated by molten welding process.
   3. Length: 8 feet.
D. Ground Lugs and Connectors for Cable Tray: Tin-plated aluminum alloy suitable for use with aluminum or copper conductors.

2.2. GENERAL
A. Grounding systems shall be installed in accordance with the requirements of the local authorities, and subject to the approval of the Architect/Engineer.
B. All ground wires and bonding jumpers shall be stranded copper installed in conduit. All ground wires shall be without joints and splices over its entire length.
C. The system neutral shall be grounded at the service entrance only, and kept isolated for grounding systems throughout the building.
D. Each system of continuous metallic piping and ductwork shall be grounded in accordance with the requirements of the National Electrical Code.
E. Mechanical equipment shall be bonded to the building equipment grounding system. This shall include but is not limited to, fans, pumps, chillers, etc.
F. PVC conduits and portions of metallic piping and duct systems which are isolated by flexible connections, insulated couplings, etc., shall be bonded to the equipment ground with a flexible bonding jumper, or separate grounding conductor.
G. Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings and other metal noncurrent-carrying parts that are to serve as grounding conductors shall be effectively bonded where necessary to assure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings so designed as to make such removal unnecessary.
2.3. SEPARATELY DERIVED SYSTEMS
   A. Equipment grounding conductors shall be provided for separately derived systems and shall be grounded to
      building steel, cold water pipes, etc., or an alternate grounding means.

2.4. RECEPTACLES
   A. Receptacles shall be grounded to the outlet box by means of a bonding jumper between the outlet box and the
      receptacle grounding terminal.

2.5. ISOLATED GROUND RECEPTACLES
   A. Isolated ground receptacles ground lug shall not be connected to the respective outlet boxes.
   B. Provide insulated ground wire for each isolated ground receptacle. Ground wire shall serve only those
      receptacles which are isolated. Route ground conductor together with phase and neutral conductors in a
      common raceway.
   C. Terminate isolated ground wire at the ground from the separately derived system serving the receptacles.
      Where not supplied by a transformer, run the isolated ground wire to the service ground bus.

2.6. CONCENTRIC KNOCKOUTS
   A. Provide grounding type bushings for conduits terminated through multiple concentric knockouts not fully
      knocked out, on inside of electrical enclosures. Install bonding jumper between ground bushing and enclosure

2.7. RAISED FLOORS
   A. Provide bonding of all raised floors.
   B. Provide insulated #4 ground from opposite ends of raised floor to panelboard serving that area.

2.8. TOGGLE SWITCHES
   A. Provide grounding clip on each toggle switch. Mount over device mounting strap such that contact is made
      between mounting strap, screw, faceplate and outlet box.
   B. Provide devices with ground screw and bond to switch box.

2.9. GROUNDING METHODS
   A. The metal frame of the building, where effectively grounded.
   B. A metal underground water piping system used for grounding shall be in direct contact with the earth for ten feet
      or more and shall be electrically continuous. Provide bonding jumpers at water meter and at insulated joints.
   C. Steel reinforcing bars used for grounding shall be encased by at least two inches of concrete, located within and
      near the bottom of a concrete foundation or footing that is in direct contact with the earth. Reinforcing bars shall
      be minimum 1/2 inch diameter and consisting of twenty feet of one or more steel reinforcing bars.
   D. All bonding jumpers for the above grounding systems shall be sized in accordance with National Electrical
      Code.

PART 3 - EXECUTION
3.1. INSTALLATION
   A. Cold Water Pipe Grounding:
      1. Make connection with clamp type fitting; do not damage water pipe.
      2. Bond ground conductor and its conduit to water pipe.
      3. Install No. 4/0 AWG bonding jumper with ground clamps around water meter.
   B. Ground Conductors:
      1. Size as shown on Drawings or as required by National Electrical Code. Grounding conductors shall be as
         shown on plans or if not specifically shown shall be no smaller than that required by the NEC.
      2. Where ground cables are required, install insulated copper ground conductors in steel conduit, or as
         indicated.
      3. Where ground cable is installed in metallic conduit, bond cable to conduit at both ends.
      4. Connect ground conductors in cables and in conduit to appropriate ground buses (as in switchgear, motor
         control centers, and distribution panelboards) or directly to metallic enclosure if no ground bus is provided.
   C. Service Ground
      1. Connect system neutral ground and equipment ground system to common ground bus.
      2. Ground secondary services at supply side of each individual secondary disconnecting means and at related
transformers in accordance with National Electric Code.
3. Provide each service disconnect enclosure with neutral disconnecting means which interconnects with insulated neutral and uninsulated equipment ground sub to establish system common ground point.
4. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.

D. Conduit Attachment to Electrical Equipment:
1. Ground conduits to metal framework of electrical equipment with double locknuts or grounding bushings and bonding jumpers unless otherwise noted.
2. Install bonding jumpers at all electrical equipment to provide continuous ground return path through conduit.
3. Install bonding jumpers across expansion fittings between conduit sections for ground path continuity.
4. Bond conduits to cable tray where conduit enters or exits tray.
5. Equipment grounding conductors for branch circuit home runs shown on the drawings shall indicate an individual and separate ground conductor for that branch circuit which shall be terminated at the branch circuit panelboard, switchboard, or other distribution equipment. No sharing of equipment grounding conductors sized according to the size of the overcurrent device and NEC Table 250-95 shall be allowed.
6. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Table 250-95.
7. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with approved pressure connectors.
8. Provide feeder servicing several panelboards with a continuous grounding conductor connected to each related panelboard ground bus. Installation shall include necessary precautions regarding terminations with dissimilar metals.

E. Circuiting
1. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder.
2. Single phase 120 volt branch circuits for lighting and power shall consist of phase and neutral conductors and a green ground conductor installed in common metallic conduit which shall serve as grounding conductor.
3. Provide flexible metallic conduit utilized in conjunction with above single phase branch circuits with suitable green insulated grounding conductors connected to approved grounding terminals at each end of flexible conduit.
4. Single phase branch circuit installed in nonmetallic conduits shall be provided with separate grounding conductor.
5. Install grounding conductor in common conduit with related phase and/or neutral conductors.
6. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.

F. Receptacles and Switches:
1. Install bonding jumpers between outlet box and receptacle grounding terminal except where contact device or yoke is provided for grounding purposes.

G. Wireways:
1. Install grounding jumpers for bonding between wireway and other panelboards, conduit, switchgear, motor control centers, and at any other point where solid connection would otherwise not provided in supporting system to insure continuous ground.

H. Underfloor Duct:
1. Install No. 8 AWG bare copper bonding jumper between underfloor duct sections on either side of expansion joint using pressure type lugs with embedding type bonding screws.

I. Dry-Type Transformers:
1. Perform grounding in accordance with N.E.C.
2. Install bonding jumper across flexible conduit from transformer housing to rigid conduit.

J. Pull Boxes, Junction Boxes and Enclosures:
1. Connect all equipment grounding conductors together and connect to the box.
3.2. FIELD QUALITY CONTROL

A. Resistance Values for System and Equipment Grounds: for each ground rod and ground grid.
   2. Method: Three (3) electrode fall of potential as prescribed by instrument manufacturer.
   3. Drive additional ground rods spaced eight feet apart, if necessary, until total resistance of system is measured at five ohms or less.

END OF SECTION 260526
SECTION 260533 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK
   A. Provide complete raceways systems, boxes and fittings for all required electrical systems.

1.3. STANDARDS
   A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
      1. Rigid Steel Conduit
         a. U.L. Standard UL-6
         b. A.N.S.I. C80-1
         c. Federal Specification WW-C-581E
      2. Intermediate Metallic Conduit
         a. U.L. Standard UL-1242
         b. Federal Specification WW-C-581E
      3. Electrical Metallic Tubing
         a. U.L. Standard UL-797
         b. A.N.S.I. C80-3
         c. Federal Specification WW-C-563
      4. Flexible Steel Conduit
         a. U.L. Standard UL-1
      5. Liquid Tight Flexible Conduit
         a. U.L. Standard UL-360
      6. Non-Metallic Conduit
         a. U.L. Standard UL-651
         b. A.N.S.I. Standard F512
         c. N.E.M.A. Standard TC-2
         d. Federal Specifications GSA-FSS and W-C-1094-A
      7. Wireways and Auxiliary Gutters
         a. U.L. Standard UL-870
      8. Rigid Aluminum Conduit
         a. A.N.S.I. C80.5

1.4. SUBMITTALS
   A. Provide manufacturer's catalog cuts of fittings.
   B. Where wireways and/or auxiliary gutters are employed full erection drawings must be submitted. Drawings to include plan views, elevations, size of wireways, type and quantity of conductors proposed to be installed therein, etc.
   C. Indicate duct banks or multi-trade coordinated shop drawings.
   D. Submit shop drawings or catalog descriptive data on boxes exceeding twenty-four (24") inches for any one dimension.
   E. Submit shop drawings or catalog descriptive for floor boxes and accessories.
PART 2 - PRODUCTS

2.1. RACEWAY TYPES

A. Standard Threaded Rigid Steel Conduit.
   1. Rigid conduit heavy wall galvanized.
   2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.

B. Intermediate Metallic Conduit
   1. Light weight rigid steel conduit.
   2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.

C. Electrical Metallic Tubing
   1. Continuous, seamless tubing, galvanized or sheradized on the exterior, coated on the interior with a smooth hard finish of lacquer, varnish, or enamel.
   2. Couplings and connectors:
      a. Indoor and two (2") inches in size and smaller, shall be steel set-screw type fittings.
      b. 2-1/2 inch size and larger must employ steel compression gland fittings.
      c. Outdoor shall be rain tight steel compression gland fittings.
   3. Thread type fittings shall not be used.
   4. All connectors shall have insulated throat.
   5. Where installed in slab or concrete work, provide approved concrete tight fittings.

D. Flexible Steel Conduit
   1. Single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel.
   2. Maximum length: (six 6) feet.
   3. Each section of raceway must contain an equipment grounding wire bonded at each end and sized as required. Provide connectors with insulating bushings.
   4. Steel squeeze-type or steel set screw type fittings.

E. Liquid Tight Flexible Electrical Conduit
   1. Same as flexible steel conduit except with tough, insert water-tight plastic outer jacket.
   2. Cast malleable iron body and gland nut, cadmium plated with one-piece brass grounding bushings which thread to interior of conduit. Spiral molded vinyl sealing ring between gland nut and bushing and nylon insulated throat.

F. Non-Metallic Raceway
   1. Composed of polyvinyl chloride suitable for 90 degrees C. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.
   2. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years experience in manufacturing the products.
   3. Materials must have a tensile strength of 7,000-7,200 psi at 73.4 degrees F., flexural strength of 12,000 psi and compressive strength of 9,000 psi.
   4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer.

G. Wireways and Auxiliary Gutters
   1. Painted steel or galvanized steel.
   2. Of sizes and shapes indicated on the Drawings and as required.
   3. Provide all necessary elbows, tees, connectors, adapters, etc.
   4. Wire retainers not less than twelve (12") inches on center.

H. Duct Banks
   1. Provide duct banks and concrete encasements for both interior and exterior work as indicated on the Drawings and for all circuits in excess of 600 volts and as otherwise indicated.
   2. Concrete shall be minimum fc = 3,000 pounds per square inch.
   3. Support raceways installed in duct banks every five (5) feet to assure correct alignment.
   4. Terminate raceways with flared bells to enable ease of pulling cable and to eliminate stress on the cable.
Free bells and raceway terminations of burrs and rough edges.
5. Provide concrete markers at grade where duct banks are stubbed out for future use.
6. Install utility duct banks not less than thirty (30") inches below grade top elevation.
7. Provide rigid steel elbows for vertical risers.
8. Provide vinyl tracer ribbon twelve (12") inches above each duct bank buried in backfill.

I. Aluminum Conduit
1. Do not use aluminum conduit unless specifically indicated on the drawings for special purposes.

2.2. LOCKNUTS AND BUSHINGS
A. Locknuts shall be steel. Die cast locknuts shall not be used.
B. All bushings shall be insulated. Use nylon insulated metallic bushings for sizes 1" and larger. Plastic bushings may be used in 1/2" and 3/4" sizes.

2.3. OUTLET, JUNCTION, AND PULL BOXES
A. Cast Type Conduit Boxes, Outlet Bodies and Fittings
1. Provide surface mounted outlet and junction boxes, in indoor locations, where exposed to moisture and in outdoor locations.
2. Use Ferrous Alloy boxes and conduit bodies with Rigid Steel or IMC.
3. Use Ferrous Alloy or cast aluminum boxes and conduit bodies with Electrical Metallic Tubing.
4. Covers: Cast or sheet metal unless otherwise required.
5. Tapered threads for hubs.
B. Galvanized Pressed Steel Outlet Boxes
1. General
   a. Pressed steel, galvanized or cadmium-plated, minimum of four (4") inches, octagonal or square, with galvanized cover or extension ring as required.
2. Concrete Box
   a. Four (4") inch octagon with a removable backplate and 3/8" fixture stud, if required. Depth of box shall allow for a minimum of one (1") inch of concrete to be poured above the backplate.
3. Switch and Receptacle Box, Indoors
   a. Nominal four (4") inches square, 1-1/2" or 2-1/2" deep as required, with raised cover unless otherwise indicated on drawings. Gangable boxes shall not be used.
4. Data/Telephone outlet box, Indoors
   a. Nominal four (4") inches square, 2-1/2" deep, with raised cover unless otherwise indicated on drawings. Gangable boxes shall not be used.
5. Lighting Fixture Box
   a. Four (4") inch octagon with 3/8" fixture stud.
   b. For suspended ceiling work, four (4") inch octagon with removable backplate where required, and two (2) parallel bars for securing to the cross-furring channels and extend flexible conduit to each fixture.
6. Plug any open knockouts not utilized.
C. Sheet Steel Boxes Indoors
1. No. 12 USS gauge sheet steel for boxes with maximum side less than forty (40") inches, and maximum area not exceeding 1,000 square inches; riveted or welded 3/4 inch flanges at exterior corners.
2. No. 10 USS gauge sheet steel for boxes with maximum side forty (40") to sixty (60") inches, and maximum area 1,000 to 1,500 square inches; riveted or welded 3/4 inch flanges at exterior corners.
3. No. 10 USS gauge sheet steel riveted or welded to 1-1/2 by 1-1/2 by 1/4" welded angle iron framework for boxes with a maximum side exceeding sixty (60") inches and more than 1,500 square inches in area.
4. Covers
   a. Same gauge steel as box.
   b. Subdivided single covers so no section of cover exceeds fifty (50) pounds.
   c. Machine bolts, machine screws threaded into tapped holes, or sheet metal screws as required; maximum spacing twelve (12") inches.
5. Paint
   a. Rust inhibiting primer; ANSI No. 61 light gray finish coat.

6. Where size of box is not indicated, size to permit pulling, racking and splicing of cables.

7. For Boxes over 600 Volts
   a. Provide insulated cable supports and removable steel barriers to isolate each feeder. Stencil cable voltage class in red letters on the front cover of the box.
   b. Braze a ground connector suitable for copper cables to the inside of the box.

D. Pull and Splice Boxes, Outdoors
   1. Aluminum reinforced, with removable covers secured by brass machine screws.
   2. Where size of box is not indicated, size to permit pulling, racking, and splicing of the cables.
   3. Braze a ground connector suitable for copper cables to the inside of the box.

E. Junction Box, Sidewalk Type
   1. Cast iron, hot-dipped galvanized with threaded conduit entrance hubs, flanged, reinforced checkered cover, gasketed with pry bar slots and countersunk stainless steel screws.

F. Floor Boxes
   1. General
      a. Class I, water-tight, normal depth cast iron construction Type I, fully adjustable, for use in concrete.
      b. Single Gang Round type.
      c. Multiple Gang or Combination.
         i. Rectangular type partitions for separating power from communication sections.
   2. Floor Box Covers
      a. Rugged construction, impervious to cleaning detergents.
      b. Compatible with floor covering.
      c. Brass or bronze for flush lid mounting with devices below floor level. Lid shall have hinged or guarded openings for wires to route through the closed lid.
      d. Providing continuous ground path to box.
      e. Provide carpet flange in carpeted areas.

G. Fire Rated Poke Throughs
   1. General
      a. 4, 6 or 8” fire rated poke throughs, UL listed for installation in fire rated concrete construction. Hubbell System One - Recessed Activation.
      b. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
      c. Comply with UL 514 scrub water exclusion requirements. Class I, water-tight, normal depth cast iron construction Type I, fully adjustable, for use in concrete.
      d. Partitions for separating power from communication sections.
   2. Covers
      a. Rugged construction, impervious to cleaning detergents.
      b. Compatible with floor covering.
      c. Brass or bronze for flush lid mounting with devices below floor level. Lid shall have hinged or guarded openings for wires to route through the closed lid.
      d. Providing continuous ground path to box.
      e. Provide carpet flange in carpeted areas.

PART 3 - EXECUTION
3.1. APPLICATION OF RACEWAYS
   A. The following applications must be adhered to except as otherwise required by Code. Raceways not conforming to this listing must be removed by this Contractor and replaced with the specified material at this Contractors expense.
1. Rigid Steel - Application: Where exposed to mechanical injury, where specifically required, exterior exposed locations, and where required by codes and for all circuits in excess of 600 volts.
2. I.M.C. - Application: Same as standard threaded rigid steel conduit.
3. E.M.T. - Applications: Use in every instance except where another material is specified. EMT shall not be used underground or in slab on grade.
4. Flexible Steel - Applications: Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings at bus duct takeoffs, at all transformer or equipment raceway connections where sound and vibration isolation is required.
5. Liquid-Tight Flexible Conduit - Applications: Use in areas subject to moisture where flexible steel is unacceptable at connections to all motors, and all raised floor areas.
6. Non-Metallic Conduit - Application: Schedule 40 - Where specifically indicated on the drawings and for raceways in slab or below grade. All bends shall be made with steel elbows and wrapped unless the bend is encased in concrete.
7. Wireways and Auxiliary Gutters - Application: Where indicated on the Drawings and as otherwise specifically approved.

### 3.2. RACEWAY SYSTEMS IN GENERAL

A. Provide raceways for all wiring systems, including security, data transmission, paging, low voltage et. al. 277/480 volt wiring shall be kept independent of 120/208 volt wiring. Emergency system wiring shall be kept independent of the normal system wiring. Where non-metallic raceways are utilized, provide sizes as required with the grounding conductor considered as an insulated additional conductor. Wiring of each type and system must be installed in separate raceways.

B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Lay out the work in advance to avoid excessive concentrations of multiple raceway runs.

C. Locate raceways so that the strength of structural members is unaffected and they do not conflict with the services of other trades. Install one (1") inch or larger raceways, in or through slabs, etc.) only when and in the manner accepted by the Architect/Engineer. Draw up couplings and fittings full and tight.

D. Install no conduits or other raceways sized smaller than permitted in applicable NEC Tables. Where conduit sizes shown on drawings are smaller than permitted by code, Contractor shall include cost for proper size conduit in his base bid. In no case reduce conduit sizes indicated on drawings or specified without written approval of Architect-Engineer.

E. Above-grade raceways to comply with the following:

1. Install raceways concealed except at surface cabinets and for motor and equipment connection in electrical and mechanical rooms. Install a minimum of six (6") inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route exposed raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run concealed raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways. Waterproof sleeved raceways where required.

2. Raceways shall not be run on roofs or exposed on the outside of the buildings unless specifically noted as exposed on the drawings or approved by the Architect/Engineer.

3. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction. Provide expansion fittings every 200 feet on outdoor conduit.

4. Provide one (1) empty 3/4 inch raceway for each three (3) spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension.

5. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling, or floors which separate adjacent rooms having substantially different maintained temperatures, as in refrigeration or cold storage rooms.

6. Provide pull string in spare or empty raceways. Allow five (5) feet of slack at each end and in each pull box. Tie each end of the string to a washer or equivalent that does not fit into the conduit. Tag both ends of string denoting opposite end termination location.

F. Below Grade

1. Below grade raceways to comply to the following:
a. Do not penetrate waterproof membranes unless proper seal is provided.

2. Protect steel raceway in earth or fill with two (2) coats of asphalt base paint. Touch up abrasions and wrench marks after conduit is in place.

3. In lieu of the above, protect steel raceways with a minimum of ten (10) mil tape approved for the purpose and overlapped a minimum of one-half tape width to provide a minimum twenty (20) mil thickness.

G. No raceway may be installed in a concrete slab or members except with the permission of the Structural Engineer and with the written consent of the Owner.

1. Conduits embedded in structural concrete slabs shall have an outside diameter less than one third of the thickness of the concrete slab and shall be installed entirely within the center one third of the concrete slab.

2. Raceways embedded in concrete slabs shall be spaced not less than eight (8”) inches on centers and as widely spaced as possible where they converge at panels or junction boxes.

3. In no case will installation of raceways be permitted to interfere with the proper placement of principal reinforcement.

4. Raceways running parallel to slab supports, such as beams, columns, and structural walls, shall be installed not less than twelve (12”) inches from such supporting elements.

5. To prevent displacement during concrete pour of lift slab, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured with suitable adhesives.

H. Non-metallic raceway installation shall conform to the following:

1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. To insure good joints, components shall be cleaned prior to assembly.

2. Raceway cut-offs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.

3. Electrical devices which are served by PVC raceways shall be grounded by means of a ground wire pulled in the raceway.

4. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the N.E.C.

5. Raceway expansion fittings shall be provided where necessary. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.

6. Raceway supports shall be installed, in such a manner, to allow the PVC conduit to slide through the supports as the temperature changes.

7. Elbows must be galvanized rigid steel, intermediate metallic conduit or concrete encased. Plastic conduit may only be used for exterior underground applications or circuits beneath slabs on grade. Provide galvanized rigid steel (GRS) radius bends and risers as conduits rise above grade or above floor slab.

8. Provide exterior underground conduit with metal detection strip.

9. Provide matching plastic fittings. Fittings shall meet the same standards and specifications as the conduit on which it is installed.

10. Joining and bending of conduit and installation of fittings shall be done only by methods recommended.

11. Provide conduit support spacing as recommended for the highest ambient temperature expected.

12. Provide interlocking conduit spacers for multiple runs of underground conduits installed in same trench.

13. Provide expansion couplings on long runs regardless of ambient temperatures. Determine amount of conduit expansion and contraction from published charts or tables.

14. Test workmanship by conducting a low-pressure air (3.0-5.0 psi) test after system is installed and cemented joints are set. Plug and block ends to prevent movement prior to pressurization. Check for leaks at all joints with a soap solution. Even low-pressure air can cause high thrust loads and caution must be observed. The test shall be observed by the architect, engineer or owner’s representative, prior to backfill.

I. Raceways in hung ceiling shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars, Z-bars, or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than 1'-0” above hung ceilings.

J. Exposed raceways shall be run parallel or at right angles with building lines. Secure raceway clamps or supports to masonry materials by toggle bolts, expansion bolts, or steel inserts. Install raceway on steel construction with approved clamps which do not depend on friction or set screw pressure alone.

K. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt, or similar material. This assembly may be pulled in together with, but ahead of, the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway which rejects ball mandrel.
L. Support raceways at intervals no greater than ten (10) feet and with one support within three (3) feet of each coupling, box, fitting, or outlet box. Provide one support within three (3) feet of each elbow or bend.

3.3. OUTLET, JUNCTION, AND PULLBOXES

A. Provide outlet, junction, and pullboxes as indicated on the drawings and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of wires and cables. J-boxes and pullboxes shall be sized per electrical code minimum. Boxes on empty conduit systems shall be sized as if containing conductors of #4 AWG.

B. Install boxes and covers for wiring devices so that the wiring devices will be installed with a vertical orientation unless otherwise noted on the drawings.

C. The exact location of outlets and equipment is governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with Architect.

D. Back-to-back outlets in the same wall, or "thru-wall" type boxes not permitted. Provide twelve (12") inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.

E. Provide twenty four (24") inch (minimum) horizontal spacing for outlets shown on opposite sides of a fire rated wall and provide listed fire putty pads around the each box to maintain fire rating.

F. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide Series "GW" (Steel City) tile box, or as accepted, or a four (4") inch square box with tile ring in masonry walls, which will not be plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of the type and size suitable for the specific application. Where outlet boxes contain two (2) or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in same box, provide suitable barrier.

G. Install top of switch outlet boxes 48" above floor unless otherwise called for or required by wainscot, counter, etc. Install bottom of receptacle outlet boxes 16" above floor unless otherwise called for on drawings. Adjust mounting heights to nearest masonry joint for minimum cutting in case of flush outlets.

H. Install all wall mounted switch and receptacle boxes with bracing between two adjacent studs where rigid conduit is not used for circuiting. Box and receptacle shall not deflect on operation or insertion of plugs.

I. Pull Box Spacing

1. Provide pull boxes so no individual conduit run contains more than the equivalent of four (4) quarter bends (360 degrees total).

2. Conduit Sizes 1-1/4" and Larger.
   a. Provide boxes to prevent cable or wire from being excessively twisted, stretched, or flexed during installation.
   b. Provide boxes for medium voltage cables so that maximum pulling tensions do not exceed cable manufacturer's recommendations.
   c. Provide support racks for boxes with multiple sets of conductors do not rest on any metal work inside box.

3. Conduit Sizes one (1") inch and smaller, low voltage wire and cable (maximum distances)
   a. 200 feet straight runs.
   b. 150 feet runs with one 90 degree bend or equivalent.
   c. 125 feet runs with two 90 degree bends or equivalent.
   d. 100 feet runs with three or four 90 degree bends or equivalent.

J. Floor Boxes

1. Prior to Concrete Pour
   a. Firmly support boxes.
   b. Adjust leveling screws to insure box covers are flush with finished floor.
   c. Plug unused opening with proper fittings and seal joints with compound for exclusion of concrete and moisture.

2. After Concrete Pour
   a. As soon as traffic is permitted on slab, remove any accumulation of water and foreign matter to avoid corrosion and rust.
   b. Insure covers are flush with finished floor.
   c. Install cover plates and accessories after floor finishing materials have been installed.
END OF SECTION 260533
SECTION 260553 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK
   A. A. Provide identification on all equipment, raceways, boxes and conductors.

PART 2 - PRODUCTS

2.1. NAMEPLATES
   A. Nameplates shall be lamacoid plates with engraved upper-case letters and beveled edges.
   B. Color:
      1. Normal-power equipment shall have white nameplates with black letters, enclosed by a black border.
      2. Equipment fed from the emergency electrical system, or otherwise designated on the plans for emergency use, shall have red nameplates with white letters, enclosed by a white border.
      3. Equipment designated as clean power shall have orange nameplates with black letters, enclosed by black border.
      4. Nameplates for short circuit ratings and calculations shall be yellow with black letters, enclosed by black border.
   C. All nameplates shall be engraved and must be secured with rivets, brass or cadmium plate screws. The use of Dymo tape or the like is unacceptable.
   D. Nameplate inscriptions shall bear the name and number of equipment to which they are attached as indicated on the Drawings. The engineer reserves the right to make modifications in the inscriptions as necessary.

2.2. CABLE TAGS AND WIRE IDENTIFICATION LABELS
   A. Cable tags shall be flameproof secured with nylon ties.
   B. Wire markers shall be preprinted cloth tape type or approved equivalent.

2.3. IDENTIFICATION LABELS
   A. Acceptable Manufacturers
      1. W.H. Brady Company (Style A)
      2. Thomas & Betts Company (T&B), Style A.
      3. Seaton
   B. Plasticized Cloth
      1. Non-conductive.
      2. Waterproof.
      3. Capable of withstanding continuous temperatures of 235 degrees F and intermittent temperatures to 300 degrees F.
      4. Overcoating for protection against oil, solvents, chemicals, moisture, abrasion and dirt.
   C. Heavy, thermo-resistant industrial grade adhesive, for adhesion of label to any surface without curling, peeling or falling off.
   D. Label Designations, Nominal System Voltages Applied to the covers of all medium and low voltage pull, splice and junction boxes.
   E. Machine printed.

PART 3 - EXECUTION

3.1. INSTALLATION
   A. Service Entrance Equipment
      1. Where electrical equipment (switchboard, panelboard, disconnect switch, etc.) is installed as service entrance equipment, contractor shall furnish and install a nameplate listing the following:
      2. Equipment Short-Circuit Current Rating in amperes (RMS SYM), as indicated on the drawings.
3. Whether or not the equipment is fully or series-rated.
4. Available Fault Current in amperes
   a. Contractor shall perform available fault current calculation (as outlined in Section 260520) to obtain available fault at Service Equipment.
5. Date fault current calculations were performed.
6. Example:

   | EQUIPMENT FULLY-RATED AT 65,000 AMPERES RMS SYM |
   | AVAILABLE FAULT CURRENT: 61,603 AMPERES        |
   | DATE CALCULATED: 12/06/2011                     |

B. Switchboards.
1. Furnish and install a nameplate for each switchboard. Nameplate shall be engraved with the following information:
   a. Top Line: Equipment identification as indicated on the Drawings.
   b. Middle Line: Specific device or equipment where feeder originates.
   c. Bottom Line: Equipment voltage, size, and phase as indicated on the drawings.
   d. Example:

   | SWITCHBOARD SWDP1 |
   | FED FROM UTILITY COMPANY TRANSFORMER               |
   | 208/120V, 1200A, 3-PHASE                           |

2. Nameplate shall be mounted at the top of the incoming section.
3. Provide on each main switch an identifying nameplate. Where multiple mains are employed each switch shall be numbered. Inscription shall be "MAIN SWITCH" or "MAIN SWITCH NO. 1" et al.

C. Panelboards and Load Centers.
1. Furnish and install a nameplate for each panelboard and load center. Nameplate shall be engraved with the following information:
   a. Top Line: Equipment identification as indicated on the Drawings.
   b. Middle Line: Specific device or equipment where feeder originates.
   c. Bottom Line: Equipment voltage, size, and phase as indicated on the drawings.
   d. Example:

   | PANELBOARD LN1 |
   | FED FROM SWITCHBOARD SWDP1 IN ROOM #332            |
   | 208/120V, 200A, 3-PHASE                            |

2. Nameplate shall be mounted at the top of the panel.
3. After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door, a neat, accurate, and carefully typed directory properly identifying the lighting, receptacles, outlets, and equipment each overcurrent device controls.
   a. Include on directory the panel or load center identification, the cable and raceway size of panel feeder, and the feeder origination point.

D. Disconnect Switches.
1. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.

E. Motor Controllers.
1. Furnish and install a nameplate for each motor controller or combination motor controller for both individual motor controllers and those in a motor control center. Engraving must indicate the motor served and the type of service (e.g., AC-8-1st floor supply, EF-2 electric closet exhaust.)
F. Feeder Switches.
   1. Furnish and install for each feeder switch including, but not limited to those in switchboards, switch and fuse panelboards, take-offs at bus ducts, motor control centers, multiple meter centers, etc., two (2) nameplates as follows:
      a. The first nameplate must be white background with red lettering. Engrave with the words "REPLACE ONLY WITH ______ FUSE." Engrave with proper fuse trade name and ampere rating (i.e. Bussman LPS-R 100).
      b. The second nameplate shall indicate the load served, the size and type of cable and raceway example:
         i. LP-4, LP-5, LP-6
         ii. 4#500 KCMIJS-THW-CU-3-1/2"C

G. Remote Smoke Detector Lamps and Test Stations.
   1. Furnish and install a nameplate on each remote smoke detector lamp and/or test station.
   2. Engraving must indicate the location of the device to which the lamp is connected, as approved by the Engineer.

H. Switches.
   1. Furnish and install an engraved nameplate for each switch, controlling loads that are not local to the switch. Engraving shall be as directed by the Engineer.

I. Receptacles.
   1. Furnish and install an engraved label on each faceplace for each receptacle indicating panel and circuit.

J. Pullboxes, Enclosures, and Cable Terminations.
   1. Circuits rated over 40 Amp and all cables over 600V:
      a. Furnish and install cable tags on each cable that enters a pullbox, enclosure, switchboard, and at terminations. Mark tags with type written inscription noting the load served, type and size of cable, and the overcurrent device protecting the cable.

K. Provide identification label with circuit numbers on enclosure cover.

L. Branch circuits:
   1. Provide identification label with panel and circuit numbers on enclosure cover.
   2. Identify each circuit with wire markers when enclosure label and wire colors do not provide enough information to identify each circuit without tracing.
   3. Provide feeders and branch circuit home runs with plasticized wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
   4. 4 square box covers hidden above lay-in ceilings may be marked with indelible ink marker in lieu of using printed labels.

M. Fire Alarm Terminal Cabinets.
   1. Furnish and install an approved nameplate on each fire alarm terminal cabinet.
   2. Nameplates shall indicate floor and where multiple terminal cabinets are installed a prime designation for each cabinet (e.g. FATC-1A, FATC-1B).
   3. Terminals shall be permanently identified in an approved manner.
   4. Label all wiring.

N. Telecommunications System.
   1. Each horizontal cable from a termination block or patch panel to a telecommunications outlet shall be labeled at both ends. Tags shall be consecutively numbered so that no two (2) cables have the same identification. In addition cable tag shall note the room number in which the data transmission outlet is located.
   2. Each backbone cable shall have a flameproof tag attached at both ends of the tag. Tags shall be consecutively numbered so that no two (2) cables have the same identification. Additional inscriptions shall be provided as directed by the Owner.
   3. Patch panel ports shall be consecutively numbered so that no two (2) ports have the same number.
O. Generator Control Panel.
   1. Furnish and install a red nameplate for each generator control panel. Engraving shall indicate the generator controlled by the panel.

P. UPS & Computer Power Centers.
   1. Furnish and install a black with lettering nameplate for each unit.

Q. Warning Signs
   1. Provide electrical equipment and accessible wiring enclosures operating at voltage above 240 volts with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications "Danger High Voltage” warning sign and voltage marker applied to front door or cover of device or enclosure.
   2. Provide large equipment such as transformers and main distribution equipment with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications indicating all electrical characteristics.

R. Boxes
   1. Provide identification labels for all low voltage and medium voltage pull, splice and junction boxes in main feeder and subfeeder runs, indicating nominal system voltage.
   2. Apply labels after painting of boxes, conduits, and surrounding areas have been completed.
   3. Clean surfaces before applying labels; clean aluminum surfaces with solvent wipe.
   4. Apply labels on cover and minimum of one (1) fixed side; one (1) label visible from floor where boxes are installed exposed.

END OF SECTION 260553
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

SECTION 260573 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Section 262413 – Distribution Switchboard
   C. Section 262416 – Panelboards
   D. Section 263213 – Diesel Engine Generators
   E. Specification Attachment No.1 – Fault Analysis and Coordination Study
   F. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

[SECTION BELOW FOR COORDINATION STUDY PERFORMED BY PKMR]

1.2. DESCRIPTION
   A. The electrical distribution system has been selectively coordinated and sized by the Engineer of Record using Cutler-Hammer equipment and an Cummins-Onan generator. Note that the isolation panelboards are manufactured by Post Glover, but the branch and main breakers are by Cutler-Hammer.
   B. Should the electrical subcontractor select alternate manufacturers; the electrical subcontractor shall select a State of Florida Registered Professional Engineer, who is familiar with the State of Florida's Agency for Health Care Administration (AHCA) requirements per their Pamphlet 59A-3 and NEC Article 517, and re-submit a coordination study to the State with the revised equipment.
      1. In addition, for quality assurance, they shall list at least three similar type projects which have been reviewed and approved by AHCA in the last 2 years.
      2. This study must accompany the submittals and be signed and sealed in accordance with Florida Law and Professional Regulation.
      3. The electrical subcontractor must include any fees associated with the State’s re-review.
   C. Any delays, job changes, or drawing changes required by use of the alternate manufacturer will be the sole responsibility of the electrical subcontractor.

1.3. STUDY REPORT
   A. Refer to attachment at end of specifications for full study.

END OF SECTION 260573

[SECTION BELOW FOR COORDINATION STUDY PERFORMED BY CONTRACTOR]

1.4. DESCRIPTION
   A. The studies shall include, but not be limited to, portions of the electrical distribution system from the power source(s) down to branch circuit protection for the electrical distribution system shown on the Riser Diagram for this project.
      1. Study shall be performed by the gear manufacturer or a Professional Engineer registered in the State of Kansas.
      2. Contractor shall submit the studies before receiving final approval from the engineer for shop drawings for the power distribution system equipment.
         a. If formal completion of the studies causes delay in equipment manufacture, approval may be obtained for a preliminary submittal of sufficient study data to verify that the information indicating device ratings and characteristics will be satisfactory.

1.5. SUBMITTALS
   A. Submit five (5) copies of study to Architect for approval. The coordination study shall be submitted with the electrical equipment shop drawings. Shop drawings for electrical equipment will not be approved without the coordination study.

1.6. DATA COLLECTION FOR THE STUDIES
   A. Contractor shall provide the required data for preparation of the studies. The primary switchgear/power
transformer manufacturer shall furnish Contractor with a listing of the required data immediately after award of the Contract.

B. Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or before release of the equipment for manufacture.

C. Characteristic data shall be derived from actual, applicable components obtained from the approved shop drawings.

D. Contractor shall obtain necessary information from the electrical service provider to perform the study.

1.7. SHORT CIRCUIT STUDY AND PROTECTIVE DEVICE EVALUATION STUDY

A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with applicable IEEE and ANSI standards.

B. The study input data shall include the power company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected and other source impedances.

C. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed 3-phase and single phase bolted short circuits at each switchgear bus, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

D. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied.

E. Problem areas or inadequacies in the equipment due to short circuit currents shall be corrected, at no additional cost to the owner.

1.8. PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the calculations and logic decisions required to select or to check the selection breaker trip characteristics and settings. The studies shall be in accordance with applicable IEEE and ANSI standards, and satisfy the requirements of the NEC.

B. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles and complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected and all breaker settings.

1. All restrictions of the National Electrical Code shall be conformed to and proper coordination intervals and separation of characteristic curves shall be maintained.

   a. In general, all devices shall be fully coordinated down to 0.1 seconds.

   b. The coordination plots for phase and ground protective devices shall be provided on a system basis.

   c. A sufficient number of curves shall be used to indicate the coordination achieved.

C. Both normal (main device to branch device) and emergency (generator breaker to branch device) studies shall be performed.

1. If provided, the generator alternator protective device shall be included in the study – coordinate exact model with generator supplier.

D. Circuit breakers of different types and/or frames sizes at each panelboard or distribution panel shall be included. Where feeder or branch breakers have not been modeled, the breakers shall be of the same style and type as similar frame size breakers in that panel.

1. Any existing devices that are part of the normal or emergency distribution systems shall be included.

E. Ground fault protection (if present on any devices that are part of the normal or emergency distribution system) shall be coordinated with same on all downstream devices.

F. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, manufacturer and type, range of adjustment and recommended settings.

G. Discrepancies, problem areas, inconsistencies or inadequacies shall be corrected, at no additional cost to the owner.

1.9. STUDY REPORT

A. The results of the Overcurrent Protective Device Coordination Study shall be summarized in a final report.

B. The report shall be prepared and stamped by a Professional Electrical Engineer registered in the State the project is located and submitted to engineer and [AHJ] for review.
C. The report shall include the following sections:
   1. Description, purpose, base, and scope of the study, and an overall single line diagram of the power system that is included within the scope of the study.
   2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding the same.
   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding the same.
   4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

PART 2 - PRODUCTS
A. Not Used

PART 3 - EXECUTION
A. Refer to applicable equipment sections.

END OF SECTION 260573
SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1. SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relay.

1.2. SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and maintenance data.

1.3. 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.

PART 2 PRODUCTS

2.1. TIME SWITCHES

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

1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Retain one of first three subparagraphs below.
4. Program: 8 on-off set points on a 24-hour schedule 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. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Five subparagraphs below describe optional features.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic dial in first subparagraph below makes the time switch self-adjusting for seasonal changes and automatically adjusts on-off times as days grow shorter or longer.
6. Astronomic time dial.
7. Eight-Day Program: Uniquely programmable for each weekday and holidays.
8. Skip-a-day mode.
9. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2. OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
4. Mounting: Twist lock complying with IEEE 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. INDOOR OCCUPANCY SENSORS

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

1. Cooper (Greengate)
2. Hubbell Lighting.
4. Philips Controls
5. Sensor Switch, Inc.
6. Steinel
7. Watt Stopper.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

2.4. LIGHTING CONTACTORS

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

2. GE.
3. Hubbell Lighting.
4. Square D.
5. TORK.
6. Watt Stopper.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.
5. The contactor shall have provisions for factory or field addition of:
   a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
   b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
   c. Control-circuit fuse holder, one or two fuses.
   d. 0.2-60 second TDE or TDD timer attachment.
   e. Transient-suppression module for control circuit of 120 volts.

2.5. EMERGENCY SHUNT RELAY

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. Lighting Control and Design, Inc.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277 V as required.

PART 3 EXECUTION

3.1. SENSOR INSTALLATION

A. 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.

B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

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.

3.3. IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4. FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.
SECTION 262413 – DISTRIBUTION SWITCHBOARD

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For each switchboard and related equipment.
      1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
      2. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
      3. Include schematic and wiring diagrams for power, signal, and control wiring.
   C. Field quality-control reports.
   D. Operation and maintenance data.

1.3. QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. Comply with NEMA PB 2.
   C. Comply with NFPA 70.
   D. Comply with UL 891.

1.4. WARRANTY
   A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. GENERAL
   A. Provide dead front type, metal enclosed, indoor switchboard arranged for service as indicated by schedules.

2.2. PRODUCT
   A. Switchboards shall be designed and tested in accordance with current applicable IEEE, ANSI Standards and equipped with the devices built in accordance with latest UL, NEC and NEMA standards. Mount switchboard on 3-1/2” high concrete base. Each switchboard, as a complete unit, shall be given a single short circuit current integrated equipment rating (IER) by the manufacturer. Such ratings shall be established by the actual tests by the manufacture, in accordance with UL specifications, on equipment constructed similarly to the subject switchboard. Integrated equipment ratings shall be as indicated on the schedules.
   B. Switchboard shall be free standing construction with front accessibility required. Provide the appropriate number of vertical sections bolted together to form one metal enclosed rigid switchboard with sides, top and rear be covered with removable screw-on code gauge steel panels. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. Provide wiring gutter space in accordance with NEC. Top and bottom conduit areas shall be clearly indicated on shop drawings.
   C. The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise. Vertical and horizontal through bus shall be tin-plated copper. The through bus supports, connections and joints are to be bolted with hex-head bolts and Belleville washers to minimize maintenance requirements and shall have provisions for the addition of future sections. Bus bar connection to branch circuit shall be “Phase Sequenced” type designed and assembled so that branch circuit devices can be removed without disturbing adjacent devices or removing main bus. Wire lugs for main bus shall be solderless, anti-tarn, front removable type suitable for copper conductors. Provide each panel with grounding bus sized per UL 891, grounded to box and grounding system. Also provide full capacity neutral bus insulated from switchboard.
   D. OVERCURRENT PROTECTION AND BRANCH DEVICES
1. MAIN OVERCURRENT PROTECTION DEVICE
   a. The main device shall be an [Electronic trip molded case full function 100% rated circuit breaker] [Electronic trip molded case standard function 80% rated circuit breaker(s)] [Thermal magnetic molded case circuit breaker(s)] [fused bolted pressure switch] [Fusible Switch].

2. GROUND FAULT PROTECTION SYSTEMS
   a. The ground fault system shall require no external power to trip the device. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided. The ground fault sensing system shall include a Ground Fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95© shall be provided. Local visual ground fault trip indication shall be provided.

3. FUSIBLE BRANCH CIRCUIT SWITCHES
   a. The switchboard group-mounted fusible branch devices are to be totally front accessible and front connectable. The fusible switch connections to the distribution panel bussing shall be of a “blow-on” design such that the connections grip the bus bars firmly under high-fault conditions.

4. CIRCUIT BREAKER BRANCH CIRCUIT DEVICES
   a. Branch circuit devices shall be [Electronic trip molded case full function 100% rated circuit breaker(s)] [Electronic trip molded case standard function 80% rated circuit breaker(s)] [Thermal magnetic molded case circuit breaker(s)].
   b. Branch circuit devices rated 800A and above shall be Electronic trip molded case standard function 80% rated circuit breaker(s) unless otherwise noted on the plans.
   c. Branch circuit devices rated 600A and below shall be Thermal magnetic molded case circuit breaker(s) unless otherwise noted on the plans.

5. THERMAL-MAGNETIC CIRCUIT BREAKERS
   a. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true rms sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.

6. ELECTRONIC TRIP CIRCUIT BREAKERS
   a. Circuit breaker trip system shall be a microprocessor-based true rms sensing design with sensing accuracy through the thirteenth harmonic. Sensor ampere ratings shall be as indicated on the schedules and drawings. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80-100% of their ampere rating continuously as specified.
   b. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.
      i. Long Time Pickup
      ii. Instantaneous Pickup
      iii. Long Time Delay
      iv. Ground Fault Pickup
      v. Short Time Pickup
      vi. Ground Fault Delay
      vii. Short Time Delay
   c. A means to seal the trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.
   d. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
E. Schedules
   1. See plans for schedules of switchboard layout. Provide switchboard with protective devices and equipment as listed on schedule.

PART 3 EXECUTION

3.1. EXAMINATION
   A. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
   B. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION
   A. Store, handle, and install switchboards and accessories per manufacturer’s recommendations.
   B. Secure the assembly in place.
   C. Provide 3 ½” housekeeping pad for mounting of switchboard.
   D. Install overcurrent protective devices and controllers not already factory installed.
   E. Install filler plates in unused spaces.
   F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

3.3. IDENTIFICATION
   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4. FIELD QUALITY CONTROL
   A. Perform tests and inspections.
      1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   B. Acceptance Testing Preparation:
      1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
      2. Test continuity of each circuit.
   C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING
   A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
   B. Set field-adjustable circuit-breaker trip ranges as indicated in the coordination study.

3.6. TOUCH UP AND CLEANING
   A. Vacuum all backboxes clean of debris after installation and prior to contract closeout.
   B. Touch up scratch marks, etc. with matching paint.

3.7. DEMONSTRATION
   A. The Contractor shall provide a training session for the owner’s representatives.
   B. A manufacturer’s qualified representative shall conduct the training session. The training program shall consist of instruction on the operation of the assembly, circuit breakers, fused switches, meters, and major components within the assembly.
SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
C. Field quality-control reports.
D. Operation and maintenance data.

1.3. QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA PB 1.
C. Comply with NFPA 70.

1.4. WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. GENERAL
A. Provide panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with fusible switches or thermal-magnetic, molded case circuit breakers as indicated on the schedules.
B. Equivalents by Square D, G.E., Eaton or ITE Siemens.

2.2. PRODUCT
A. BUSSING ASSEMBLY AND TEMPERATURE RISE:
   1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50 degrees C rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67.
   2. Provide tin-finished copper bars full length of panel with rating listed in schedule. Bus bar connection to branch circuit breakers shall be “Phase Sequence” type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable for copper or aluminum conductors. Provide each panel with equipment tin finished copper grounding bus grounded to box and tin finished copper neutral bus insulated from box.
B. INTEGRATED EQUIPMENT SHORT CIRCUIT RATING

1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating as indicated in the schedules. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

C. CABINET

1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Provide branch circuit panelboard cabinets with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. Endwalls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electrodeposited over cleaned phosphatized steel. Fusible panelboards and large distribution circuit breaker panelboards shall not be provided with doors.

D. SAFETY BARRIERS

a. The panelboard interior assembly shall be dead front type with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

E. UL LISTING

a. Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. When required, panelboards shall be suitable for use as service equipment.

F. OVERCURRENT PROTECTION AND BRANCH DEVICES

1. BRANCH CIRCUIT BREAKERS

a. Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self-protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall open and close all poles of a multipole breaker simultaneously. Conforming to NEMA Standards Publications No. AB1-1964 and be approved by UL. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Multiple pole trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one pole.

b. Provide arc-fault protection circuit breakers for all sleeping rooms and other areas required by code.

2. FUSIBLE SWITCHES

a. The fusible switches shall be horsepower rated, quick-make, quick-break and shall be mounted in panel-type construction. Switches shall have plug-on side connections and shall have built in fuse pullers. Each switch is to be contained in a separate steel enclosure. The enclosure will employ a hinged cover for access to the fuses which will be interlocked with the operating handle to prevent opening the cover when the switch is in the "on" position. This interlock shall be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service. The units shall have padlocking provisions in the "off" position, i.e., red for "on" and black for "off". Fusible switch units shall be interchangeable without disturbing adjacent units and be properly supported to prevent vibration and breakage during shipment and handling.

b. Fuse holders shall be high-pressure type for use with Class R fuses. Main switch fuse holder shall be set up for use with UL Class R fuses. Provide rejection clips for fuse holders where rejection type fuses are called for or shown.
PART 3 EXECUTION

3.1. EXAMINATION
   A. Examine panelboards before installation. Reject panelboards that are moisture damaged or physically damaged.
   B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION
   A. Store, handle, and install panelboards and accessories per manufacturer’s recommendations.
   B. Secure the assembly in place.
   C. Provide 3½” housekeeping pad where two or more conduits penetrate floor or when equipment is floor/ground mounted.
   D. Wall-mounted equipment:
      1. Mount bottom of trim a minimum of 24” above finish floor. Maintain accessibility to overcurrent devices per NEC. Where both conditions cannot be met, consult with engineer on mounting height of equipment.
      2. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
      3. Where flush mounted, the fire integrity of the wall in which it is installed must be maintained.
      4. Where flush mounted provide (2) 2” conduits from the can to above an accessible ceiling and terminate with a minimum 8”x8” junction box located in a concealed manner.
   E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon “Ty-Raps”, or approved equal at minimum 4 inch intervals.
   F. Plug all knockouts removed and not utilized.
   G. Install overcurrent protective devices and controllers not already factory installed.
   H. Install filler plates in unused spaces.

3.3. IDENTIFICATION
   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”
   B. Panelboard Nameplates: Label each panelboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”
   C. Device Nameplates: Label each disconnecting and overcurrent protective device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”
   D. For panelboards (and distribution panelboards where labeling of individual breakers is not possible or practical), provide a typed circuit directory for same as follows:
      1. Panels shall have branch circuit directory holders with clear plastic cover.
      2. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers. Handwritten directories are not acceptable.
      3. For remodel work or changes, trace circuits to determine loads and provide new updated directory.

3.4. FIELD QUALITY CONTROL
   A. Perform tests and inspections.
      1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   B. Acceptance Testing Preparation:
      1. Test insulation resistance for each panelboard bus, component, connecting supply, and feeder.
      2. Test continuity of each circuit.
   C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING
   A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
B. Set field-adjustable circuit-breaker trip ranges as indicated in the coordination study.

3.6. TOUCH UP AND CLEANING

A. Vacuum all backboxes clean of debris after installation and prior to contract closeout.
B. Touch up scratch marks, etc. with matching paint.

3.7. OBSERVATIONS

A. All panel fronts shall be removed by the Contractor for observation of the panel interiors by the Engineers.
B. Panel fronts shall be removed when directed by the Engineer/Architect for observation and reinstalled immediately after the observations.

END OF SECTION 262416
SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
   C. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

1.3. 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. GENERAL
   A. Manufacturers
      1. Manufacturers’ Names: Shortened versions (shown in parentheses) of the following manufacturers’ names are used in other Part 2 articles:
         a. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
         b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
         d. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
   2. All devices shall be from the same manufacturer.
   B. Finishes
      1. Color: Wiring device catalog numbers in Section Text do not designate device color.
         a. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NFPA 70 or device listing.
         i. Color shall be coordinated and verified with Architect and owner.
         c. Isolated Ground Devices: Orange.
         d. TVSS Devices: Blue.

2.2. STRAIGHT BLADE RECEPTACLES
   A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
      1. Products: Subject to compliance with requirements, provide one of the following:
         a. Cooper; 5351 (single), 5352 (duplex).
         b. Hubbell; HBL5351 (single), CR5352 (duplex).
         c. Leviton; 5891 (single), 5352 (duplex).
         d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3. GFCI RECEPTACLES
   A. General Description: Straight blade, feed or non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Where devices are shown labeled as GFI on drawings provide GFCI receptacle.
   B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; GF20.
   b. Hubbell
   c. Leviton
   d. Pass & Seymour; 2084.

2.4. HOSPITAL GRADE RECEPTACLES
   A. Receptacles installed at patient bed locations and in operating/procedure rooms shall be hospital grade.
   1. Refer to NEC 517 for definitions.

2.5. EMERGENCY RECEPTACLES
   A. Receptacles denoted as “Emergency” shall be red in color, and denoted as such with a device plate labeled with the word “EMERGENCY” in capital letters.

2.6. USB RECEPTACLES
   A. Convenience receptacle with USB charging ports, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Two USB charging ports, minimum 3.6 A, compatible with USB 1.0/2.0 devices. Tamper-resistant or hospital grade as required.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper.
      b. Hubbell, USB20X2
      c. Leviton, T5832
      d. Pass & Seymour.

2.7. ISOLATED GROUND RECEPTACLES
   A. IG receptacles shall be 3 wire grounding type NEMA No. 5-20R-IG. Receptacle shall be constructed with Nylon face and base; .050 gauge brass nickel-plated backstrap with isolated ground design; riveted self-grounding clip; and .040 gauge solid brass, nickel-plated, triple-wipe contacts. Receptacles shall be orange.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Hubbell
      c. Leviton
      d. Pass & Seymour; 2084.

2.8. SURGE SUPPRESSION RECEPTACLES
   A. Surge Suppression receptacles shall be isolated ground, duplex receptacle design, rated 20 ampere, 120 Volts and shall contain surge suppression device to protect appliances served by the receptacle. Receptacles shall provide 13,000 Amps Maximum Surge Current Line to Neutral; 6,500 ampere Maximum Surge Current Line to Ground; and 6,500 ampere Max. Surge Current Neutral to Ground; each based on IEEE C62.41, * X 20 us waveform. Receptacle shall be certified by UL 1449 to have maximum clamping voltage of 500 Volts Peak Line to Neutral, Line to Ground, and Neutral to Ground based on Class B, 6KV, 3KA impulse, and shall be suitable for ANSI/IEEE C62.41-1980 installation categories A and B. Receptacles shall have a blue faceplate. Receptacle shall have an audible alarm.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper.
      b. Hubbell
      c. Leviton
      d. Pass & Seymour.

2.9. CLOCK OUTLETS
   A. Clock Outlets shall be equipped with recessed grounded receptacle mounted in a satin stainless steel plate.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper.
2.10. TAMPER-RESISTANT RECEPTACLES
A. Furnish/install tamper-resistant receptacles in lieu of "standard" receptacles at all of the following locations, regardless of plan designation:
   1. Dwelling units (all receptacles of the non-locking type).
   2. Guest rooms and guest suites
   3. Child care facilities
   4. Exceptions:
      a. Receptacles located more than 7' above the floor.
      b. Receptacles located behind an appliance that is not easily moved.
B. Tamper-Resistant Receptacles shall be safety type, "childproof," duplex, 3 wire, ground type rated 15 or 20 amperes at 125 volts.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper
      b. Hubbell
      c. Leviton
      d. Pass & Seymour

2.11. SNAP SWITCHES
A. Comply with NEMA WD 1 and UL 20.
B. Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Catalog numbers in subparagraphs below are for 20-A devices; revise catalog numbers if 15-A devices are desired.
      b. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      c. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
      d. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      e. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
C. Pilot Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221PL for 120 V and 277 V.
      b. Hubbell; HPL1221PL for 120 V and 277 V.
      c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
      d. Pass & Seymour; PS20AC1-PLR for 120 V.
   2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
D. Key-Operated Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221L.
      b. Hubbell; HBL1221L.
      c. Leviton; 1221-2L.
      d. Pass & Seymour; PS20AC1-L.
   2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.12. WALL-BOX DIMMERS
A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
1. 600 W; dimmers shall require no derating when ganged with other devices.
2. 2000 W; dimmers where required by load.

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

E. Dimmer Switches for LED fixtures: Modular; compatible with dimming drivers in fixture(s); if other than 0-10V dimming is provided, verify dimmer is compatible with driver for full range of dimming (100-10%).

2.13. OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; 6111 for 120 V, 6117 for 277 V.
   b. Hubbell; WS1277.
   c. Leviton; ODS 10-ID.
   d. Pass & Seymour; WS3000.
   e. Steinel; IL WLS 1.
   f. Watt Stopper (The); PW-101.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

B. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Hubbell; ATP1600W RP.
   b. Leviton; ODWWV-IRW.
   c. Pass & Seymour; WA1001.
   d. Steinel; IL WLS 1.
   e. Watt Stopper (The); CX-100.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..

2.14. SPECIAL PURPOSE DEVICES

A. Provide where indicated, specified or as required other appropriate NEMA configured devices appropriate for such equipment as thru-wall units manufactured by the same manufactures.

2.15. WALL PLATES

A. Single and combination types to match corresponding wiring devices.

   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable in-use cover.

2.16. FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
B. Compartments: Barrier separates power from voice and data communication cabling.
C. Service Plate: solid brass with satin finish.
D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.17. SINGLE AND MULTIPLE STATION (120V) DETECTORS

A. Smoke Detectors:
Detector shall comply with the following:

a. UL 217 (Standard for Single and Multiple Station Smoke Alarms)

b. Suitable for residential occupancies per NFPA 101

2. Detector shall be a dual-sensor (combination photoelectric and ionization detection) model.

3. Operate at 120V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.

4. Auxiliary Relays: Provide as required.

5. Test Switch: Push to test; simulates smoke at rated obscuration.

6. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.

7. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

8. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.

9. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

10. Where indicated on plans, provide Audible (Sounder) and/or Visual Base(s) for detector(s).

B. Combination Smoke/Carbon Monoxide Detectors:

1. Same as above requirements for smoke detectors, except as modified below:

2. Smoke detection may be by a photoelectric sensor only.

3. Comply with UL 2034 (Standard for Single and Multiple Station Carbon Monoxide Alarms).

C. Duct Smoke Detectors:

1. Comply with UL268A.

2. Sensor: LED or infrared light source with matching silicon-cell receiver.

   a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot when tested according to UL 268A.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.

   a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

D. Audible (Sounder) Bases:

1. Listed to UL 268, 464, & 2075.

2. Base shall include the following selectable tones (as required):

   a. Smoke: ANSI Temporal 3

   b. Carbon Monoxide: Temporal 4

E. Visible Base:

1. Shall include a 177-cd strobe.

PART 3 EXECUTION

3.1. INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is...
troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtailed.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Wall plates shall not support wiring devices. Provide wiring device with accessories as required to properly install devices and wall plates.
11. All devices shall be flush-mounted except as otherwise noted on the drawings.
12. Locations
   a. Comply with layout drawings for general location; contact Owner’s Representative for questions about locations and mounting methods.
   b. Relocate outlets obviously placed in a location or manner not suitable to the room finish.
   c. Avoid placing outlets behind open doors.
   d. Align devices vertically and horizontally. Device plates shall be aligned vertically with tolerance of 1/16”. All four edges of device plates shall be in contact with the wall surface.
13. Mounting Heights as indicated on the Drawings and according to ADA requirements.
14. Ganging of Switches - provide barriers between ganged 277 volt switches of different phases.
15. Power Outlets - install power outlets complete with back boxes, where installed in existing buildings or extensions of existing buildings. Coordinate phase connections for rotating equipment with connections in existing building.
16. Install device plates on all outlet boxes. Provide blank plates for all empty, spare and boxes for future devices.
17. Caulk around edges of outdoor device plates and boxes when rough wall surfaces prevent a raintight seal. Use caulking material as approved by the Architect/Engineer.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up.

F. Device Plates:
1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
2. Provide matching blank wall plates to cover outlet or junction boxes intended for future devices.
3. Provide matching blank wall plates with 4 port knock outs at all telephone, data, and tele/data outlet locations. Also provide with matching blankouts in each port.
4. Where wall plates for special devices are available only from manufacturer of device, provide designs and finishes equivalent to above specification.
5. Verify with Architect finish of any plate where it may be apparent a special finish or color should have been specified.

G. Switches
   1. Where switches are indicated to be installed near doors, corner walls, etc., mount same not less than 2 inches and not more than 18 inches from trim. Verify exact locations with the Architect.
   2. Carefully coordinate the location of switches to insure locations at the strike side of doors.
   3. Furnish and install an engraved legend for each switch that controls exhaust fans, motors, equipment systems, etc., not located within sight of the controlling switch.

H. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers’ device listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2. IDENTIFICATION
   A. Comply with Division 26 Section "Identification for Electrical Systems."
      1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3. FIELD QUALITY CONTROL
   A. Perform tests and inspections and prepare test reports.
      1. Test Instruments: Use instruments that comply with UL 1436.
   B. Tests for Convenience Receptacles:
      1. Test for correct wire terminations (no open ground, neutral, or hot).
      2. Test for correct polarity (no hot/ground reverse or hot/neutral reverse).
      3. Verify GFCI devices are operating properly.
      4. Using the test plug, verify that the device and its outlet box are securely mounted.

END OF SECTION 262726
SECTION 262813 – FUSES

PART 1 GENERAL

1.1. SUBMITTALS

A. First paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Action Submittal."
B. Product Data: For each type of product indicated.
C. Paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Informational Submittal."
D. Operation and maintenance data.

1.2. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA FU 1 for cartridge fuses.
C. Comply with NFPA 70.

PART 2 PRODUCTS

2.1. FUSES

A. PRODUCT

1. Provide fuses by Bussman or Gould Shawmut.
2. Provide fuses of same characteristics as scheduled to insure selective coordination of power system.
3. Fuses 601 amp and larger shall be U/L Class L with minimum four (4) seconds time delay at 500% rating.
4. Fuses 600 amp and below shall be U/L Class J, RK-1 or RK-5 as scheduled time delay sized as shown on drawings or schedules.
5. Special temperature conditions, motors, motor loads or other conditions requiring other types or sizes of fuses must be reviewed by the Contracting Officer. Fuse reducers are not permitted.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer’s catalog number.
B. Furnish Owner with spare fuses of each size and type installed on job as follows:
   1. 601 Amps or Larger - three (3) of each size and type
   2. 600 Amps or Less - 10% with minimum of three (3) of each size and type
C. For fuse types and ampcapities, see plans.
D. Provide spare fuse cabinet with three shelves.
E. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262813
SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
   B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
      1. Wiring Diagrams: For power, signal, and control wiring.
   C. Field quality-control reports.
   D. Operation and maintenance data.

1.3. QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1. DISCONNECT SWITCHES
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Eaton (Cutler-Hammer)
      2. General Electric Company
      3. Siemens
      4. Square D
   B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
   C. Accessories:
      1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
      2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
      3. Lugs: Suitable for number, size, and conductor material.
      4. Service-Rated Switches: Labeled for use as service equipment.

2.2. FUSIBLE SWITCHES
   A. Refer to disconnect switches for all requirements in addition to the following.
   B. Switches shall be furnished with clips or bolt pads to accommodate indicated fuses.
   C. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front without removing the fuse.
   D. Accessories:
      1. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.3. MOLDED-CASE CIRCUIT BREAKERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Eaton (Cutler-Hammer)
      2. General Electric Company
      3. Siemens
      4. Square D
   B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
   C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous
magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Electronic Trip Circuit Breakers (where indicated on drawings or elsewhere in this specification): Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I2t response.

E. Features and Accessories (where called for or required):

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4. ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2. IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3. FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816
SECTION 262913 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS
   A. Reference Section 260500.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS
   A. Product Data: For each type of enclosed controller.
   B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
      1. Wiring Diagrams: For power, signal, and control wiring.
   C. Field quality-control reports.
   D. Operation and maintenance data.

1.3. QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1. MOTOR STARTERS
   A. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.
      1. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.
      2. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer’s installation requirements.
   B. MAGNETIC MOTOR STARTERS
      1. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
      2. Enclosures shall be NEMA type required by starter location and environment.
      3. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
      4. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
      5. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
      6. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer’s overload selection tables. Keep record of thermal unit number and current range.
      7. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
      8. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
      9. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
     10. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.
   C. COMBINATION MAGNETIC MOTOR STARTERS
      1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in
accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
2. Starter NEMA enclosure type shall be type required for starter location and environment.
3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
6. All fuse holders shall have rejection clips installed.
7. See plans for combination magnetic starters.

D. MANUAL MOTOR CONTROL (1 HP Maximum)
1. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
2. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
3. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
4. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

PART 3 EXECUTION

3.1. INSTALLATION
A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
D. Install fuses in each fusible-switch enclosed controller.
E. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
G. Comply with NECA 1.

3.2. IDENTIFICATION
A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3. CONTROL WIRING INSTALLATION
A. Install wiring between enclosed controllers and remote devices[ and facility's central control system]. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
B. Bundle, train, and support wiring in enclosures.
C. Connect selector switches and other automatic-control selection devices where applicable.
1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4. FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.
C. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
   5. Test each motor for proper phase rotation.
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING

A. Set field-adjustable switches and overload-relay pickup and trip ranges.
B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

3.6. DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913
SECTION 265100 – LUMINAIRES, LAMPS AND BALLASTS

PART 1 - GENERAL

1. RELATED DOCUMENTS

A. Reference Section 260500.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, specifications.
B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, finishes, and accessories.
C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
D. Field quality-control test reports.

PART 2 - PRODUCTS

2.1. INSPECTION

A. Prior to installation of luminaires Electrical Contractor shall inspect luminaire and verify unit meets or exceeds specifications, is new and unused without damage or defect and is suitable for the intended service.
B. See architectural and electrical plans for luminaire locations, coordinate installation with other trades. At the completion of the project all luminaires shall be aligned, level and cleaned to the satisfaction of the A/E.

2.2. EQUIVALENT MANUFACTURERS

A. The following light fixture manufacturers are generally approved equals to those manufacturers listed in the Lighting Fixture Schedule on the drawings. The approval herein no way relieves the contractor of meeting all specification requirements. All light fixtures substituted for fixtures specified on drawings must conform in materials, dimensions, appearance, performance, and be of equal quality to the fixture specified and described in the Lighting Fixture Schedule. Fixture manufacturers not listed here must be submitted and approved a minimum of 10 days prior to bid.
B. Provide luminaires by the following manufacturers:
C. Downlights:
   1. Category 1: (Only Category 1 fixtures may be substituted for Category 1 fixtures specified on the drawings). Calculite, Edison Price, Focal Point, Kirlin, Kurt Versen, Rambusch, RSA, USA Lighting
   2. Category 2: (Category 1 or Category 2 fixtures may be substituted for Category 2 fixtures specified on the drawings). Elite, Halo, Hubbell, Indy, Intense, Lightolier, Lithonia, Marko, Pathway, Prescolite, Portfolio, Spectrum, Williams, Zumtobel
D. Fluorescents: Columbia, Cooper (Metalux), Daybrite, Elite, Finelite, Focal Point, Lithonia, Williams
   1. Equivalent troffers shall be considered the following: Columbia (PS Series), Cooper (Metalux GC Series), Daybrite (SP Series), Elite (OT Series), Finelite (HPR Series), Lithonia (SP Series), Williams (50 Series)
E. Undercounter: Columbia, Color Kinetics, Daybrite, Elite, Fail-Safe, Lithonia, Metalux, Nulite, WAC, Williams
F. Strip Fluorescents: Birchwood, Columbia, Daybrite, Elite, Lithuania, Metalux, Paramount, Prudential, Williams
G. Linear/Tubes: A Light, Corelite, Finelite, Focal Point, Ledalite, Linear Lighting, LiteControl, Metalumen, Peerless, Precision, Prudential, Williams, Zumtobel
I. Indirect: Ametrix, Elliptipar, Engineeried Lighting Products, Focal Point, LiteControl, SPI, Zumtobel
J. HID: ABS Lighting, Daybrite, Gardco, G.E., Holophane, Hubbell, Lumark, Kim, Lithonia, SPI, Williams
K. Exit Signs and Emergency Lights: Beghelli, Chloride, Concealite, Devine, Dual-Lite, EELP, Elite, Emergi-Lite, Evenlite, Extronix, Fail-Safe, Hubbell, Lithonia, Prescolite, Surelites, Williams
L. Security/Vandal Resistant: Daybrite, Eclipse, FailSAFE, Holcor, Kenall, Kirlin, L.C. Doane, Moldcast
M. Hazardous Locations: Appleton, Chloride, Cross-Hinds, Daybrite, Dialight, Dual-Lite, Halo, Hubbell, Kirlin, L.C. Doane, Paramount, Phoenix
N. Outdoor: ABS Lighting, Antique Street Lights, Architectural Area Lighting, Bega, Beta Calco, Daybrite, Devine,

O. Track Lighting: Alfa, Bruck, Elite, Halo, Intense, Lithonia, Lightolier, Lighting Services Inc., Lite Lab, Marko, Prescolite
P. LED lamps and Modules: Philips, General Electric, Osram/Sylvania, Cree, Nichia.
Q. LED Power Supplies: Osram/Sylvania, General Electric, Philips.

2.3. LUMINAIRES

A. Provide luminaires complete with lamps and accessories required for hanging. Contractor shall insure that lamps, reflector lens and trim are clean at time of final inspection. Mount recessed luminaires with trim flush to ceilings, free of gaps or cracks.
B. Coordinate mounting of ceiling mounted luminaires with General Contractor. Where additional supports are required due to luminaire location or weight, electrical contractor shall provide supports, unless otherwise specified under ceiling specifications.
C. Consult architectural plans and existing conditions where applicable for ceiling types and provide surface and recessed lighting fixtures with appropriate mounting components and accessories. Verify mounting requirements prior to ordering and shop drawing submission.
D. Fixtures mounted in fire rated ceilings shall be provided and installed with fire rated enclosures to maintain ceiling integrity. Provide engineered products by EZ-Barrier, Tenmat or similar products or provide enclosures fabricated in accordance with building code and UL requirements. Maintain all fixture required heat sink and other clearances.
E. Provide troffer luminaires with the following devices wherever and not specified otherwise on the luminaire schedule: cam latches, 100% door gasketing, post fabrication painted finish, t-bar clips, lens clips, suspension tabs, and a minimum of 0.125” lens.

2.4. LAMPS

A. Lamps shall be lamp types recommended by luminaire manufacturer. Lamp no fixtures above manufacturers recommended maximum wattages.
B. Incandescent lamps shall be inside frosted (IF) type unless otherwise called for in luminaire schedule.
C. Low-Mercury Fluorescent Lamps: Comply with EPA’s toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1
D. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 32 W maximum, nominal length 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.
E. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
F. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
G. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
H. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
I. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
J. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
K. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.
L. MR16 Halogen Lamps: 12V, 10,000 Hours Average Life, Universal Burn Position, Color Temperature - 3100K, Spot, Narrow Flood, and Flood beam spreads. Ushio Ultraline only.
M. Equivalent lamps by General Electric, Venture, Phillips, Sylvania, or Eiko.

2.5. BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant and programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. 120/277 dual rated.
1. Sound Rating: A.
2. See Evaluations for discussion of harmonic considerations.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Consider specifying the higher frequency in subparagraph below if fixtures with default ballasts are used in proximity to infrared sensors.
6. BF: 0.88 or higher.
7. Power Factor: 0.98 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 42 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

E. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: 50 percent of rated lamp lumens.
2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.6. BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 42 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.


B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.7. LED LIGHTING SYSTEMS


B. The LED module itself and all its components must not be subject to mechanical stress.

C. Assembly must not damage or destroy conducting paths on the circuit board.

D. Installation of LED modules (with power supplies) shall adhere to all applicable electrical and safety standards.

E. Correct polarity shall be clearly identified.

F. LED module must be protected from unbalanced voltage, and/or overload.

G. Ensure that the power supply is of adequate power to operate the load.

H. Install system according to manufacturer’s heat sinking parameters.

I. For applications involving exposure to humidity and dust, the module shall be protected by a fixture or housing with a suitable protection glass. The module shall be protected against condensation water by treatment with an appropriate circuit board conformal coating. The conformal coating should have the following features.

1. Optical transparency
2. UV resistance
3. Thermal expansion properties matching those of the module (15-30 x 10-6cm/cm/K)
4. Low permeability of steam for all climate conditions
5. Resistance against corrosive environments

J. The LED module shall be operated with an electronically stabilized power supply offering protection against short circuits, overload, and overheating.

K. All drivers used for supplying power to LED arrays in lighting fixtures shall be by the light fixture manufacturer.

L. Drivers shall be integral to the fixture unless otherwise shown or specified.

2.8. EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1200 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

2. Night-Light Connection: Operate one fluorescent lamp continuously.

3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.


5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

6. Provide 5-year warranty.

7. Battery packs shall be Bodine B-50 or Iota I-232. Equivalent by Lithonia.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

2. Night-Light Connection: Operate one fluorescent lamp in a remote fixture continuously.


5. Housing: NEMA 250, Type 1 enclosure.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Provide 5-year warranty.

2.9. EMERGENCY LED DRIVER

A. Emergency LED driver specified herein is by Iota (CP Series). Approved equals by Bodine.
   1. The emergency driver shall accommodate an LED load with a forward voltage requirement ranging from 10 to 60 VDC.
   2. The output voltage sensing shall be automatic and instantaneous with a resulting, inversely-proportional current to maintain constant power to the LED array with an output tolerance of +/- 3%.
   3. The unit shall supply the rated load for a minimum of 1 1/2 hours or to 87 1/2% of the rated battery terminal voltage.
   4. The output power to the LED load during emergency operation shall be held constant (refer to plans for wattage) from minute one throughout the entire emergency run time resulting in no loss or degradation of the light source during emergency operation.
   5. The unit shall be furnished with an electronic, AC-lockout circuit which will connect the battery when the AC circuit is activated, and an electronic brownout circuit which will enable a transfer to emergency operation when utility power dips below an acceptable level.

B. Installation
   1. Emergency drivers shall be UL-listed for use with respective LED array and/or UL-listed for field installation. Where drivers are only listed for use with a respective LED array, they shall be installed integral to the fixture by the fixture manufacturer.
   2. Maximum remote mounting distance of the emergency driver shall be 50-feet

C. Driver: Constant Power emergency LED driver system as indicated on the plans. The emergency driver system shall be UL class 2 certified in accordance with UL 1310 and shall be UL listed for use in damp locations with a temperature range of 0° to 55° C.

D. AC input: Two-wire, universal voltage capable 120 thru 277 VAC, 50/60 Hz and be UL Classified to Category Control Number (CCN) FTBR, Emergency Lighting and Power Equipment, and FTBV, Emergency Light-Emitting-Diode Drivers for field installation.

E. Battery: Self-contained, high-temperature, sealed, maintenance-free nickel cadmium battery rated for a 10-year service life.

F. Charger: two-stage charging system which samples the battery in relation to its temperature, state of charge and input voltage fluctuations. The charger shall be current limited, temperature compensated, short-circuit protected with reverse polarity protection. The unit shall achieve a full recharge in 24-hours.

G. Protection: A low voltage battery disconnect (LVD) circuit shall be provided and will disconnect the load and circuitry from the battery when it reaches approximately 80 to 85% of its nominal terminal voltage, preventing a non-recoverable, deep-discharge condition as well as equipment initialization failure when utility power is restored.

H. Housing: NEMA 250, Type 1 enclosure.

I. Test Push Button: Illuminated push-to-test switch.

J. Provide 5-year warranty.

2.10. BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
   1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
   3. Normal Ambient Operating Temperature: 104 deg F.
   4. Open-circuit operation that will not reduce average life.
   5. Low-Noise Ballasts (all interior fixtures): Manufacturers’ standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
   1. Lamp end-of-life detection and shutdown circuit.
   2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. See Evaluations for discussion of CFR compliance required in first subparagraph below.
8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output. (where specified on plans)

D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
   a. Restrike Range: 105- to 130-V ac.
   b. Maximum Voltage: 250-V peak or 150-V ac RMS.
2. Minimum Starting Temperature: Minus 40 deg F.
3. Open-circuit operation shall not reduce average lamp life.

2.11. POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.
   1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
   2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers’ mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.12. STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
   1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: [Single-arm] [Truss] [Davit] type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
   1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
   3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect.

2.13 ALUMINUM POLES
A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
   1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
   2. Finish: Same as pole and luminaire.
E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect from manufacturer's full range.

2.14 POLE ACCESSORIES
A. Base Covers: Manufacturers’ standard metal units, arranged to cover pole’s mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION
3.1 LUMINAIRES
A. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.
B. Reference luminaire schedule on plans for specific luminaire, lamp, and ballast requirements.
C. Reinstall any fixtures called out for relocation or remounting in renovation areas as though they are new fixtures. Make all provisions to properly mount and support existing fixtures being reused.
D. Luminaires submitted must meet or exceed specified luminaire in performance and construction and appearance. Provide luminaires at each location shown on drawings. Luminaires shall be in accordance with type designation on drawings.
E. Luminaire supports shall comply with the latest edition of the NEC Sections 410-30 and 410-36. Provide luminaire securing clips or otherwise securely fasten fixtures to ceiling grid. At least two support wires shall be connected from the structure above to each troffer style light fixture.

3.2 INSTALLATION
A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.
C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
   1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
D. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit.

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length of fixture chassis, including one at each end.

E. Air-Handling Lighting Fixtures: Install with dampers open and ready for adjustment.
F. Adjust aimable lighting fixtures to provide required light intensities.
G. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.
H. Recessed luminaires installed in rated assemblies shall be installed per UL listing requirements to maintain the rating of the construction. Provide sheet rock enclosures or other UL listed manufactured assemblies to maintain rating of construction and listing of fixtures for heat dissipation and clearances.

3.3. POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
B. See Evaluations for structural- and soil-engineering coordination.
C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
   2. Install base covers, unless otherwise indicated.
   3. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
E. Raise and set poles using web fabric slings (not chain or cable).

3.4. BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.
B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

3.5. INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRIES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.6. CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7. GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole, unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole.
   2. Install grounding conductor and conductor protector.
   3. Ground metallic components of pole accessories and foundations.

3.8. FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results.
If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100
END OF DIVISION 260000