

Project Manual

FOR

MLBO Housing Warehouse Remodel

District II

20898 360th Street, McGregor, MN 55760

BID ISSUE
June 17th, 2024



Owner

Mille Lacs Band of Ojibwe

Community Development

43408 Oodena Drive

Onamia, MN 56359

Tel: (320)532-4181

Architect

BUSCH Architects, Inc.

310 Fourth Avenue South

Suite 1000

Minneapolis, MN 55415

Tel: (612) 333-2279





Community Development **REQUEST FOR PROPOSAL**

OWNER: MILLE LACS BAND OF OJIBWE
43408 OODENA DRIVE
ONAMIA, MN 56359

DATE ISSUED: June 18, 2024

BID DATE: July 24, 2024

PROJECT: DII Housing Warehouse Remodel

TO: Qualified General Contractors

THIS IS NOT A CHANGE ORDER NOR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED HEREIN.

The Mille Lacs Band of Ojibwe, Community Development office will be accepting sealed lump sum bids for commercial remodel work to renovate the DII Housing Warehouse, located at 20898 360th St., McGregor, MN. Bids will be due Wednesday, July 24, 2024 at 3:00 PM. Bids received will be opened and qualified by the Mille Lacs Band of Ojibwe on Thursday, July 25, 2024 at 10:00 AM.

A mandatory pre-bid site visit will be held on: Tuesday, June 25, 2024 at 9:30 AM.

General Notes:

1. It is the Contractors responsibility to identify any and all discrepancies in the scope of work, not meeting Industry Standards or that which is inconsistent with the International Building Code (IBC), and Project design documents as prepared by Architectural Resources Inc.
2. All electrical wiring, apparatus and equipment for electric light, heat and power, technology circuits or systems shall comply with the rules of the Department of Commerce or the Department of Labor and Industry, as applicable, and be installed in conformity with accepted standards of construction for safety to life and property.
3. Contractor must reconnect all utilities, service panel or service feed. Also includes gas, propane. Include such equipment or materials identified in the pre-bid conference.
4. Contractor will secure all permits and fees.
5. Contractor is responsible for a thorough investigation of the scope of work.
6. Contractor will repair any damage to the property or structure created by the scope of work.
7. Contractor shall be responsible for all debris removal related to all work performed under this work scope.
8. Contractor to carry Builder's Risk insurance on project for duration of construction.
9. NO WORK SHALL BE PERFORMED UNTIL ALL REQUIRED PERMITS HAVE BEEN ISSUED AND COPIES IN THE POSSESSION OF THE PROJECT COORDINATOR AND /OR MILLE LACS BAND BUILDING OFFICIAL.

COMMUNITY DEVELOPMENT WILL, TO THE GREATEST EXTENT FEASIBLE, GIVE PREFERENCE IN THE AWARD OF CONTRACT TO INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES.

Work Scope:

We are renovating this 10,240 sq ft warehouse facility to protect the structure and make better use of the space to assist with staff efficiency. Work will include selective demolition and layout changes to the building floor plan. Interior work includes door replacements, finishes, LED lighting, painting, HVAC upgrades, and electrical work. A training/ break room will be added to include a second bathroom. Exterior improvements include adding a concrete block wainscot, exterior lighting, security cameras, door replacements and deletions, septic system repair, perimeter security fence and parking lot paving.

1. Refer to Busch Architects & Associates DII Warehouse Remodel McGregor Plan Set Commission No. 23-11. Project Manual including specifications and design drawings will be provided to bidding contractors. General Contractor to perform all construction activities as defined in the plans and specifications as identified by Busch Architects & Associates for the DII Housing Warehouse Remodel project.
2. Bids must be honored for 90 calendar days.
3. Anticipated project schedule is Fall 2024 to Summer 2025.
4. Contractor shall include 0.5% TERO tax fee in base bid. Contractor shall utilize FEDERAL Davis Bacon wage rates for construction of this project. Wage determination rates for Aitkin County will be provided in the first pre-bid addendum.
5. Refer to the project Bid Form for the listing of Bid Alternates. This will be issued in the first pre-bid addendum.
6. Project is sales tax exempt. Awarded contractor will be provided with the tax exemption form.
7. Project Retainage is 10%.
8. The Housing Warehouse is an occupied facility and daily operations will continue during construction. Continuous cleaning operations, temporary barricades and other measures will need to be taken to limit disruption to daily building operations. Minimal parking and delivery restrictions will be required during construction. Building access points will be discussed at the pre-bid site visit.
9. Contractor shall be required to provide portable toilet facilities for work staff.

Specified Product Substitutions: All proposed product substitutions shall be submitted in accordance with the project specifications. Any approved substitutions, will be made available to all bidders via Pre-Bid Addendum.

Contacts:

Interested bidders shall contact Carla Dunkley – Compliance & Residential Projects Manager at 320-630-2495 or at carla.dunkley@millelacsband.com to receive a link to the complete plan set and specs for this project and to be included on the bidder's list in the event that any addendums are issued.

Mobilization:

1. The Contractor shall be capable of mobilizing his equipment and crews within seven days of the receipt of Notice to Proceed.
2. Contractor shall submit building schedule to Owner at the time of contract signature by the Contractor.

3. Contractor shall provide means and methods for all building phases of construction.

Bidding notes:

1. Submit signed proposal in lump sum (supply and install), not to exceed amount
2. All Contractors (including subcontractors) must comply with Commercial Davis Bacon wage requirements (Mille Lacs County).
3. All Contractors must provide the following along with their bid submittal:
 - a. Completed and signed MLB Community Development Construction Bid Form
 - b. A copy of Current MLB Vendor's License (or a copy of the submitted application)
 - c. A copy of Current Insurance Certificate
 - d. A copy of Subcontractor/Material Supplier list
 - e. A copy of Authorized Signature Sheet (submitted with first bid submittal)
4. All Contractors must comply with all Mille Lacs Band of Ojibwe American Indian Employment requirements (see 18 MLBSA § 5). Contact Lori Trail at (320) 532-4778.

All proposals MUST be mailed and labeled as follows:

**Mille Lacs Band of Ojibwe
Commissioner of Community Development
Sealed bid: DII Housing Warehouse Remodel
P.O. Box 509
Onamia, MN 56359**

**Please note that the bids must be submitted via mail to the P.O. Box. FedEx and UPS will not deliver to a P.O. Box and the Onamia post office will not accept hand delivered items. Please plan accordingly to ensure the timely receipt of your bid submittal. **

****The Band reserves the right to reject any bid that it is unable to collect at the Onamia post office by the bid deadline date and time, provided that the Band has made diligent and reasonable efforts to collect the bid. The Band reserves this right even in the event that the bid has been postmarked before the deadline.**

PROPOSALS NOT SUBMITTED IN THIS MANNER WILL BE REJECTED.

COMMUNITY DEVELOPMENT/PROJECT MANAGEMENT RESERVES THE RIGHT TO REJECT ANY AND ALL BIDS FOR ANY REASON.

PERMIT AND CONTRACTOR REQUIREMENTS:

Permits: Contractors are responsible to attain all necessary permits for all work, including Mille Lacs Band of Ojibwe (MLBO) Permits.

Licensing:

1. Firms must be licensed with the Mille Lacs Band of Ojibwe. A copy of this license (or the license application) must accompany each bid. Licensing process can take several weeks. If you are not currently licensed with the MLBO, please submit a copy of your license application along with your proposal. Contact Elizabeth Thornbloom at (320)532-8274 or by email at EThornbloom@grcasinos.com with questions regarding licensing and for the license application.

Bonding Requirements: In accordance with 2016 MLB Project Specification Book.

MLBSA Section 17 Procurement Statue Ordinance 03-06 states the following:

Section 17. Bonding

- A. In construction contracts that are federally funded or deemed commercial, bonding is required. These types of contracts shall demand a performance bond not less than twenty (20%) percent of the total contract price, but not to exceed \$500,000.00. A performance bond requirement is to ensure that, if a contractor defaults, the Band may request that the surety pay the expense incurred to complete the construction contract.

- B. In addition, all construction contracts identified as federally funded or commercial shall be covered by a payment bond equal to one payment installment or cover subcontractors/suppliers as determined by the Contracting Officer or his agents. The payment bond must contain language stating that if the contractor fails to make a payment to its subcontractors/suppliers, the surety will make the necessary payment.

CONSULTANTS



Civil Engineer

Larson Engineering, Inc.

3524 Labore Road
White Bear Lake, MN 55110-5126
651.481.9120 Fax: 651.481.9201

M EYER | B O R G M A N | J O H N S O N

STRUCTURAL DESIGN + ENGINEERING

Structural Engineer

Meyer Borgman Johnson

510 S Marquette Ave,
Unit 900
Minneapolis, MN 55402
612.339.0713



Mechanical and Electrical Engineer

Emanuelson Podas Engineering, Inc.

7705 Bush Lake Rd,
Edina, MN 55439
Tel: 952.930.0050

SECTION 00 00 02 - PROFESSIONAL CERTIFICATIONS

Architect

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly licensed **Registered Architect** under the laws of the State of Minnesota.

Amanda Maldonado, AIA

Reg. No. 58977

Civil Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly licensed **Professional Engineer** under the laws of the State of Minnesota.

Eric Meyer, P.E.

Reg. No. 44592

Structural Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly licensed **Professional Engineer** under the laws of the State of Minnesota.

Chris Scheevel, P.E.

Reg. No.

Mechanical Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly licensed **Professional Engineer** under the laws of the State of Minnesota.

Scott A Vander Heiden, P.E.

Reg. No. 40918

Electrical Engineer

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision, and that I am a duly licensed **Professional Engineer** under the laws of the State of Minnesota.

Matthew W. Fults, P.E.

Reg. No. 40887

PROJECT MANUAL

for the General Construction of

**Mille Lacs Band of Ojibwe
DII Warehouse Remodel - McGregor**

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MLBO DII Warehouse Remodel
McGregor, MN

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Community Development

BIDDING REQUIREMENTS AND CONTRACT FORMS

SECTION I – INSTRUCTION TO BIDDERS

Bidding Requirements and Contract Forms

1. QUALIFIED BIDDERS

- a. To be a qualified bidder, contractors must meet the following criteria:
 - i. Contractor must possess a valid Minnesota State Contractors License, unless not specifically required for the project on the RFP.
 - ii. Contractor must be licensed with the Mille Lacs Band of Ojibwe Corporate Commission Business Regulation Offices, or have a pending application.
 - iii. Contractor must partake in any pre-bid meetings required on the bid posting.

*Any contractor not meeting these criteria will be considered not eligible to bid on the project, and the bid will be rejected.

2. QUALIFIED BIDS

- a. To submit a qualified bid, contractors must meet the following criteria:
 - i. Contractor must be a qualified bidder.
 - ii. Bids must be sealed and submitted as indicated in Request for Proposal.
 - iii. Bids must be clearly marked for project being bid.
 - iv. Bids must arrive to the location specified on the RFP by the date and time announced or they will be rejected.
 - v. Bids must have all required submittals, including:
 - a. MLB Bid Form (must be signed by bidder)
 - b. MLB Bid Breakdown Spreadsheet (payment application spreadsheet)
 - c. MLB Vendor's License – copy of current license or copy of application of the same
 - d. Current Insurance Certificate (Builder's risk required on all projects)
 - e. Letter from Bond Surety, if required
 - f. A Copy of the MN State Contractors License, if required
 - g. Sub-contractor list
 - i. include name
 - ii. phone number
 - iii. contract value
 - vi. Bids must meet any other criteria listed on the bid posting.

*Any bids not meeting these criteria will be considered a non-qualified bid and will be rejected.

3. PRE-BID INFORMATION

- a. To receive information for the project being posted for bid, refer to the bid posting for the Project Coordinator's contact numbers and pre-bid meetings scheduled.
- b. Specification books and plans are available on CD format see bid posting.

4. PRODUCT SUBSTITUTION REQUIREMENTS

- a. Any Contractor wishing to submit product data for substitution must submit product data at least five days prior to the bid deadline date to be considered. Any approved product substitutions shall be made available to all bidders through a pre-bid addendum identifying any such approved products.
- b. Product substitutions will not be considered after the bid date.

5. BID AWARD

a. Bidder will be notified by if they are to be awarded a contract. This award letter is not a notice to proceed with any work. Unless the project is for an emergency service, contractor should not, under any circumstances, perform work without a fully executed contract.

END OF SECTION

FY 2024 CONSTRUCTION BID FORM
REQUIRED FOR ALL BIDS

FIRM NAME: _____

JOB/PROJECT: THIS IS A SAMPLE BID FORM: PROJECT SPECIFIC BID FORM IS INCLUDED IN THE RFP

LUMP SUM PRICE:
(LUMP SUM PRICE INCLUDING ALL LABOR AND MATERIALS)

_____ \$ _____
(Written Value) (Dollar Amount)

ALTERNATE #1 (IF APPLICABLE):

_____ \$ _____
(Written Value) (Dollar Amount)

Acknowledgement of Addendum(s): 1) _____ date 2) _____ date 3) _____ date

BID GUARANTEE PERIOD:

I agree to hold this bid open for a period of **90 days** after the bid opening. If this bid is accepted I agree to execute a Contract and/or a Purchase Order with the Mille Lacs Band of Ojibwe along with furnishing all required bonding (if required) and insurances.

TERO COMPLIANCE:

I understand that this company, its subcontractors and all employees performing work on this project will be expected to comply with all Mille Lacs Band TERO Compliance Regulations. Upon being informed that I will be awarded a contract for this project, I will submit all required TERO Compliance Plans directly to the MLB TERO Office for review and approval.

Acknowledgement of TERO Compliance: _____

ATTACHMENTS REQUIRED: Failure to provide any of these attachments will result in bid disqualification.

- MLB BID FORM (MUST BE SIGNED)
- MLBO VENDOR LICENSE
- COPY OF CURRENT INSURANCES
- LETTER FROM BONDING SURETY (If required)
- COPY OF MINNESOTA CONTRACTORS LICENSE, if required
- SUB-CONTRACTOR LISTS (Include values)

NAME: _____ **TITLE:** _____

SIGNATURE: _____ **DATE:** _____

FIRM NAME: _____ **TELEPHONE:** _____

ADDRESS: _____

SECTION III – PERFORMANCE AND PAYMENT BONDS
Bidding Requirements and Contract Forms

1. MLBSA Section 17 Procurement Statute Ordinance 03-06 states the following:

Section 17. Bonding

- A. In construction contracts that are federally funded or deemed commercial, bonding is required. These types of contracts shall demand a performance bond not less than twenty (20%) percent of the total contract price, but not to exceed \$500,000.00. A performance bond requirement is to ensure that, if a contractor defaults, the Band may request that the surety pay the expense incurred to complete the construction contract.
- B. In addition, all construction contracts identified as federally funded or commercial shall be covered by a payment bond equal not less than twenty (20%) percent of the total contract price, but not to exceed \$500,000.00. The payment bond must contain language stating that if the contractor fails to make a payment to its subcontractors/suppliers, the surety will make the necessary payment.
- C. Bonding may also be required for other projects, as determined by CMD Project Management staff. If so, the RFP will note the requirement.

END OF SECTION

SECTION IV – INDIAN EMPLOYMENT RIGHTS

Bidding Requirements and Contract Forms

- 1. Title 15: Chapter 4: Tribal Employment Rights Office (pg67-102)**
- 2. TERO Contractor Overview**
- 3. TERO Compliance Plan Form**

SECTION V – MILLE LACS CONSTRUCTION CONTRACT
Bidding Requirements and Contract Forms

CONSTRUCTION CONTRACT between MILLE LACS BAND of OJIBWE (OWNER)
And (CONTRACTOR)

The Project # is:

CONTRACT entered into as of the day of in the year .

BETWEEN the Owner:
Mille Lacs Band of Ojibwe
43408 Oodena Drive
Onamia, MN. 56359

OMB APPROVAL
Date:
Signature:
Vendor #
Oblg #
Account #
Contract Sum: \$ _____

and the Contractor

OSG APPROVAL
Date:
Signature

ADMINISTRATION POLICY BOARD
Date:
Signature

BAND ASSEMBLY APPROVAL
Date:
Signature

THIS CONTRACT AND ALL OF ITS TERMS AND CONDITIONS ARE TO BE GOVERNED UNDER THE
LAWS OF THE MILLE LACS BAND OF OJIBWE INDIANS.

Section 1

NOTICE.

Inclusion of address, phone, fax and email are mandatory

- | | |
|--|---|
| (A) The Owner's representative is:
[Name] -Contracting Officer
[Address]
[Phone]
[Fax] | Contracting Officer's designee:
[Name] -- C.O. Designee (Project
Coordinator or Manager)
[Address]
[Phone]
[Fax] |
|--|---|

The Contractor's representative(s) is (are):

[Name]
[Address]
[Phone]
[Fax]
[Email]

The Contractor's representative(s) is (are):

[Name]
[Address]
[Phone]
[Fax]
[Email]

(B) All notices are to be sent to the stated representatives, unless a change in the information above is required. If a change in the above referenced information is required, then a notice of a change of representatives must be provided in writing within five (5) working days, including any change of address, phone, fax or email.

(C) Notices to either party shall be given by addressing the communications to the stated representative. Any notice given is effective upon receipt by U.S. Mail, postage prepaid, or upon personal delivery with acknowledgement of receipt.

Notice may also be given through electronic format, by fax or email, using the attached coversheet entitled Legal Notice.

Section 2

WORK/WORK STATEMENT/SCOPE

- (A) Objectives: to precisely identify desired end objectives of the project and associated requirements.
- (B) Definitions: For purposes of this contract, the term "Project" will be synonymous with the word "Work." Work shall be defined as the tasks completed in order to achieve the final creation or renovation of the desired structure.
- (C) Please attach a **Schedule of Values** that outlines the project first in general terms and dates, and then provides a detailed breakdown of each construction phase, the materials needed for each phase, the cost of those materials and the estimated completion date for each. Schedules of values, which should be considered an itemized list of supplies, labor and completion phases should provide the Contracting Officer with a clear understanding of the anticipated percentage of completion for each phase and its cost. Schedules of Values need to be attached to this document upon completion of the Work.

See Work Project No. and project address

(C) Responsibility: identify all Mille Lacs Band and Contractor participation or cooperation that is needed for the success of the project, as well as the nature and extent of all task responsibilities. All tasks requiring Mille Lacs

Band support (e.g. Band-furnished equipment, facilities, materials or other government assistance) should be stated specifically.

(D) Milestones/Schedule of Values: generate a schedule for the sequence of tasks to be performed by a contractor and a similar schedule for related responsibilities of the Owner.

Section 3

CONTRACT SUM

The Contract Sum is _____, subject to adjustments as determined by the Owner or Contract Officer.

Section 4

DATE OF COMMENCEMENT AND CONTRACT TIME

The date of commencement of the Work is the date the Mille Lacs Band Office of Management and Budget (OMB) issues the 1st payment after receipt of Contractor's 1st Application for Payment. The Contract Time shall be measured from the date of commencement.

Section 5

PAYMENTS

Progress Payments

(A) All pay applications for payment are subject to the Office of Management and Budget (OMB) processing schedule. Once an application for payment is received, and Certificates for Payment issued by the Owner, along with the approval of the Commissioner of Community Development, or his/her designee, the Owner shall make payment within thirty (30) days as provided below.

Project Manager shall choose one of the following payment schedules marked in subsection (B), all other provisions of this section shall still apply.

() (B) Payment schedule based on a **Schedule of Values** that will be determined by the attachment of an Application and Certificate of Payment as well as a Continuation Sheet. Each of these documents will be considered part of the overall contract as approved by the Contracting Officer or his/her designee.

() (B) (2) *this option is available only for road construction contracts.* Unit price work. Work to be paid for on the basis of unit prices in an attached sheet. Unit price work will be subject to an attached set of conditions.

Substantial Completion

(C) The Contractor shall achieve Substantial Completion of the Work not later than _____. **(Insert expected date of final completion. Attach copy of document indicating formal approval/ratification date or specifically cite completion date).**

(D) The Substantial Completion date of the Work is the date when construction is sufficiently complete so that the Owner can occupy or utilize the building for its intended purpose. Only two (2) extensions may be given for substantial completion of a project.

(E) The Work is not substantially completed if it fails to conform to approved Drawings and Specifications, any Change Order, or if construction defects remain that prevent occupancy or utilization of the building.

Liquidated Damages

(F) Liquidated Damages. Should the Contractor fail to substantially complete the Work within the time allowed in this Contract, the Contractor shall pay the owner as liquidated damages no more than \$_____ per day for each consecutive calendar day that Substantial Completion remains unmet, but not to exceed \$_____ per week. Liquidated damages shall be assessed according to a graduated scale listed as follows:

Contract Type	Contract Price	Liquidated Damages
Renovation only	\$0.00 -- \$50,000.00	\$100.00 per day completion unmet
	\$50,001.00 – higher	\$200.00 per day completion unmet
Residential (full construction)	\$0.00 – 150,000.00	\$300.00 per day completion unmet

	\$150,001.00 – higher	\$400.00 per day completion unmet
Commercial (full construction)	\$0.00 --	\$400.00 per day completion unmet

If the Contractor and Owner have mutually agreed to a signed Change Order and/or Addendum granting an extension of time to reach Substantial Completion, then the liquidated damages shall be calculated from the date agreed to in the Addendum and/or Change Order. In no way shall the costs for liquidated damages be construed as a penalty. Owner and Contractor agree that the sum is a reasonable and proper measure of the damages that cannot be calculated with any degree of certainty, which the Owner will sustain if the Contractor fails to substantially complete the Work according to the Schedule of Values and/or Substantial Completion deadlines in this Contract.

(G) In the event that the contractor fails to cure defects in performance as provided in section 8 of this Contract, the Owner shall have the right, but not the obligation, to complete the punch list items. Final Payment in the amount of (\$) shall be made when punch list items are done and keys are exchanged. Final Payment (RETAINAGE) shall be paid within thirty (30) days of i) completion of the punch list items in a good and workmanlike manner and (ii) submission of all closeout documentation to the Owner.

(H) Lien Waivers.

(1) For each Application for Payment, the Contractor shall provide lien waivers for the General Contractor, Subcontractors, Sub-subcontractors, and suppliers for Work performed since the previous payment application was submitted to the Owner before the Contractor has the right to receive any payment on its current Application for Payment. All lien waivers shall be provided in the form attached as Exhibit A.

(2) In the event Contractor fails to pay any Subcontractors, Owner shall have the right, but not the obligation, to pay the Subcontractor directly upon receipt of a lien waiver from the Subcontractor, and subtract the amount paid from the Contract Sum.

i. Any payments made by Owner pursuant to this paragraph will be subject to a reasonable administration fee which will be deducted from the Contract Sum. Contractor shall be notified by a written statement when an administration fee is deducted from the Contract Sum.

(I) Changes.

(1) The Band's Contracting Officer may at any time, in writing, make reasonable and /or necessary changes within the general scope of the contract.

(2) If any change is requested by the Contractor that causes an increase or decrease in the cost of, or the time required for performance of any part of the Work under the contract, the Contract Officer is authorized to make an equitable adjustment of a maximum of five percent (5%) in the contract sum. An equitable adjustment will be a fair adjustment made within a reasonable time. Adjustment of a contract in excess of five percent (5%) of the Contract sum must be approved by the Band Assembly for contracts over \$100,000.00. The Contracting Officer may also make an equitable adjustment in the schedule of values. Failure of the parties to agree to any adjustment shall be covered under the Disputes Clause as a claim. However, nothing in this section or the Disputes Clause shall excuse the Contractor from proceeding on the work.

(3) Change order mark-up limit of 10% on all labor and materials.

(4) No payments will be made for additional work performed under the terms of this contract without written approval from the Owner prior to work being performed.

Section 6

TERMINATION BY OWNER FOR CONVENIENCE

(A) The Owner may at any time and for any reason terminate this Contract for convenience. A termination notice citing this section will be delivered in writing to the Contractor's representative and will set forth a date upon which the termination will be effective.

(B) Upon receipt of this notice from the Owner, the Contractor shall immediately cease to incur any costs that may be chargeable to the Owner under this Contract.

(C) In a termination for convenience, the contractor shall also prepare to discontinue performance of the Work in the manner set out below.

1. The Contractor agrees that upon receipt of notice from the Owner it shall:
 - i. cease any and all Work under the Contract in the manner directed by the Owner in the notice;
 - ii. take whatever action(s) necessary, or which may be directed by the Owner, for the protection and preservation of the Work;
 - iii. terminate all existing subcontracts and purchase orders except for work directed in the notice to be performed prior to the effective date of termination;
 - iv. enter into no further subcontracts and purchase orders; and
 - v. assign subcontracts and purchase orders to the Owner as directed.

(D) Following a termination for convenience, the Owner shall be responsible only for payment for services rendered before the effective date of termination. The Owner agrees that it will pay the Contractor within thirty (30) calendar days from the Contractor's submission of a final Application for Payment to the OMB, if the application is approved by the Owner.

(E) Under no circumstance shall the Owner be charged equipment rental in excess of seventy-five percent (75%) of the value of that item (or for any item with a value of \$500 or less) acquired by the Contractor to the date of termination. The Owner will not pay termination charges for any subcontracts, and the Owner shall not be liable for any lost profits or consequential damages.

i) From this amount shall be subtracted the aggregate of all previous payments made by the Owner and other credits due to the Owner. The Owner shall be immediately refunded any amount by which payments to the Contractor exceed the amount of payment to which the Contractor is entitled.

(F) To the extent that the Owner elects to accept legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall execute, deliver and take all steps necessary to effect the legal assignment of such subcontracts, purchase orders and agreements prior to receiving the payments referred to in this Section.

Section 7

TERMINATION BY OWNER FOR CAUSE

(A) The Owner may terminate this contract for cause upon default by the Contractor. Any notice of default will be delivered to the Contractor, and the Contractor's Surety, in writing. The Owner's right to terminate a contract may be exercised if the Contractor does not cure such default within ten (10) business days after receipt of notice from the Contracting Officer specifying default. More time to cure may be provided if deemed reasonable by Owner.

(B) The Contract may be terminated for cause if the Contractor shall be deemed in default. The Contractor shall be deemed in default if the Contractor:

1. Persistently or repeatedly fails or refuses to supply enough properly skilled workers or proper materials;
2. Fails to make payment to Subcontractors for materials or labor in accordance with respective agreements between the Contractor and Subcontractors;
3. Persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction over the Work;
4. Fails to deliver the supplies or perform the services within the time specified in the contract or any agreed upon extension;

5. Fails to make progress, so as to endanger performance of the contract;
6. Fails to maintain the appropriate insurance under § 13 and § 15 of this Contract;
7. Fails to perform any of the other provisions of the contract; or
8. Violates the requirements contained in the Mille Lacs Band of Ojibwe Commercial Practices Act, Chapter 5 regarding TERO Compliance. See 18 MLBSA § 401-428; or
9. Is otherwise in material breach of a provision of this Contract.

(C) Any complaint received by the Administration Policy Board regarding a contractor's failure to comply with TERO rules, will be investigated immediately. If the complaint is determined to be worthy of further consideration, the Administration Policy Board shall notify the parties of an appointed time and day for a hearing and settlement discussions. At this time, the Band may terminate the contract for convenience immediately. If settlement is not achieved, the Administration Policy Board may render its own decision based on the evidence and testimony presented. Any decision of the Administration Policy Board under this statute may be appealed to the Court of Central Jurisdiction under 24 MLBSA § 2501. If the Administration Policy Board issues a final decision rendering the complaint against the contractor unfounded, the contractor may seek reimbursement of the contract sum.

(D) This Contract will be terminated for cause if, after written notice and hearing, the Administration Policy Board determines that the Contractor or its representative offered a gratuity to an official, agent or employee of the Band, and intended by the gratuity to obtain a contract or favorable treatment under a contract.

(E) If the Owner terminates this contract, it may acquire supplies or services similar to those terminated to complete the Work. The Contractor will be liable to the Owner for any dollar amounts exceeding the Contract Sum for those supplies or services required to finish the Work.

(F) When the Owner terminates the Contract for one of the reasons stated in subsections A-D of this section, the Contractor shall not receive further payment until the Work is finished.

(G) When any of the above reasons exist, the Owner may without prejudice to any other rights or remedies of the Owner:

1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery owned by the Contractor;
2. accept assignment of subcontracts; and
3. finish the Work by whatever reasonable method the Owner may deem expedient.

(H) If the unpaid balance of the contract sum exceeds the costs of finishing the Work, including compensation for administrative and necessary consultant services, and other costs incurred by the Owner, then such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid shall be certified by the Owner, upon application, and this obligation for payment shall survive termination of the Contract.

(I) Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

(J) If, after termination, it is determined that the Contractor was not in default, or that the default was excusable or justified, the termination shall be deemed a termination for convenience, and the right and obligations of the parties shall be the same as if the termination had been issued for the convenience of the Band.

Section 8

SUSPENSION BY THE OWNER FOR CONVENIENCE

(A) The Owner may, for convenience, order the Contractor to suspend the Work for such a period of time as the Owner may deem appropriate. The suspension notice will be communicated by the Owner's representative and will be effective immediately. A confirmation of this suspension will be delivered in writing to the Contractor's representative within twenty-four (24) hours from the decision to suspend.

(B) In the event of a suspension under this section, the Contract Sum will be adjusted for increases in cost. Adjustments to the Contract Sum shall include lost profit.

(C) The Contract Time will be adjusted to coincide with any Work delay caused by suspension unless the Contract Time is subject to non-adjustment for the reasons set out below.

1. No adjustment of Contract Time shall be made to the extent that performance of the Work is, was, or would have been suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

2. No adjustment of contract time shall be made if an equitable adjustment is made under another provision of the contract.

Section 9

TERMINATION BY THE CONTRACTOR

(A) The Contractor may terminate this contract if the Work is stopped for a period of forty-five (45) calendar days through no act or fault of the Contractor, subcontractors, their agents or employees or any other persons or entities performing portions of the Work. The Contractor may also terminate the contract if the Work is stopped for a period of thirty (30) calendar days, through no act or fault of the Contractor, subcontractors, their agents or employees, for any of the following reasons:

1. issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped;
2. an act of government, such as a declaration of national emergency which requires all work to be stopped;
3. because the Owner has not issued a Certificate of Payment and has not notified the Contractor of the reason for withholding certifications; or
4. because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract.

(B) The Contract may be terminated if the Work is stopped for a period of thirty (30) consecutive days through no act or fault of the contractor, subcontractors, their agents, employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract with respect to matters important to the progress of the Work.

(C) The Contractor may terminate the contract if, through no act or fault of the Contractor, subcontractors, their agents, employees or any other persons or entities performing portions of the Work under contract with the Contractor, as a result of repeated suspensions, delays or interruptions of the entire Work by the Owner, the Work is delayed for more than one-hundred percent (100%) of the total number of days scheduled for completion, or 120 working days in any 365 day period, whichever is less.

(D) If one of the reasons described in subsections (A) or (C) exists, the Contractor may, upon ten (10) calendar days written notice to the Owner, terminate the contract and seek to recover from the Owner payment for work executed and for proven loss with respect to materials, equipment, tools, construction equipment and machinery, including reasonable overhead, profits and damages.

Section 10

DISPUTE RESOLUTIONS

(A) The Contractor agrees that all disputes which arise under this Contract, to the exclusion of subsections 8(C) and 8(D), will be adjudicated in the Court of Central Jurisdiction for the Mille Lacs Band. The contractor also agrees that, by signing this contract, the contractor consents to the personal jurisdiction of the Court of Central Jurisdiction. This contract will be deemed a service contract provided for the needs of Band members. See 5

MLBSA 113(e). The Contractor agrees that all interpretations of this Contract will be based upon the laws of the Mille Lacs Band.

(B) Any claim by the contractor shall be submitted in writing to the Band's Contracting Officer for a written decision. A claim by the Band against the Contractor, to the exclusion of subsections 8(C) and 8(D), shall be subject to a written decision by the Contracting Officer.

1. "Claim" as used in this section, means a written decision, demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of the contract terms, or other relief arising under or relating to the contract.

(C) A voucher, invoice or other routine request for payment that is not in dispute when submitted is not a claim. It may be converted to a claim, by complying with the submission requirements of this section, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(D) The Contracting Officer's decision shall be final unless the Contractor appeals the matter within ten (10) days of the Contracting Officer's decision to the Court of Central Jurisdiction for the Mille Lacs Band. The Court shall review the decision of the Contracting Officer under an arbitrary and capricious standard.

(E) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal or action under the contract, and comply with any decision of the Contracting Officer or the Band's Court of Central Jurisdiction.

Section 11

ADDITIONAL REMEDIES

(A) Notwithstanding the remedies provided in other paragraphs of this Contract, the Owner reserves the right to commence legal action against the Contractor seeking monetary damages, liquidated damages, declaratory or injunctive relief as allowed by law, or any other relief in order to enforce any of its rights under this agreement.

(B) Except for defaults of subcontractors, the Contractor shall not be liable for any excess costs if the failure to perform the contract arises from causes beyond the control and without the fault or negligence of the Contractor.

(C) If the failure to perform is caused by the default of a subcontractor and if the cause of the default is beyond the control, and without the fault or negligence of either the Contractor or the subcontractor, the Contractor shall not be liable for any excess cost for failure to perform, unless the subcontracted supplies or services were obtainable from other sources in sufficient time for the Contractor to meet the required delivery schedule.

(D) The Owner shall pay the contract sum for completed services performed and accepted. The Owner may withhold from these amounts any sum the Contracting Officer determines to be necessary to protect the Owner against loss. Failure to agree on such a sum will be a dispute under the Disputes Clause.

(E) If, after termination, it is determined that the Contractor was not in default, or that the default was excusable, the rights and obligations of the parties shall be the same as if the termination had been issued for the convenience of the Owner.

(F) The right and remedies of the Owner in this clause are in addition to any other rights and remedies provided by the law or under the contract.

Section 12

JURISDICTION

The Court of Central Jurisdiction is hereby granted subject matter jurisdiction for any cause of action which arises from this contract. See 5 MLBSA 111. Contractors, by signing this agreement, consent to the personal jurisdiction and the subject matter jurisdiction of the Court of Central Jurisdiction. Contractors seeking relief for claims shall be

afforded the opportunity to seek relief in tribal court only to the extent of the contents of a properly filed claim under this contract's dispute resolution section. No claims will be permitted beyond the Contract Sum.

Section 13

INDEMNIFICATION – REIMBURSEMENT- INSURANCE – WORKERS COMPENSATION – SUBROGATION WAIVERS

(A) To the fullest extent permitted by law, the Contractor agrees to indemnify and hold harmless the Mille Lacs Band of Ojibwe and all its members, entities, officers, agents and employees, from all suits, liens, charges (including attorneys' fees, costs & disbursements), damages, and liabilities relating to personal or bodily injury, sickness, illness, death, and damage to or destruction of property in any manner connected with the execution of the Work provided for in this Contract.

(1) Indemnification for property damage under this section consists of any work or omission of Work contracted to be done by Contractor or his subcontractors, employees, or agents.

(2) Indemnification for the aforementioned damage could also occur when the Contractor, Subcontractors or suppliers use materials, equipment, instrumentalities, or other property, regardless of whether or not harm is caused in part by a party indemnified. Excluded from this list are claims, loss, damage, costs or expenses resulting from risks that the Owner is required to insure against.

(3) The Contractor also agrees, without limiting any indemnification under subsection (1), to indemnify and hold harmless the Owner, its agents and employees, from such claims, damages, or liabilities for which the Owner, its agents and employees may be liable.

(4) The Contractor agrees to reimburse the Owner, its agents and employees for all costs and disbursements, including attorneys' fees, paid or incurred to enforce the provisions of this section.

(5) The Contractor, furthermore, agrees to obtain, maintain, and pay for such general liability coverage and endorsements (including product and completed operations coverage) as will ensure the provisions of this section.

(B) In claims against any person or entity indemnified under subsection (A) by an employee of the Contractor, a subcontractor, or anyone directly or indirectly employed by them, the indemnification obligation under subsection (A) shall not be limited by an amount or type of damages, compensation or benefits payable under workers' compensation acts, disability benefit acts or other employee benefit acts.

(C) To the fullest extent permitted by law, and without limiting any other indemnification obligation of the Contractor, the Contractor shall indemnify and defend the Mille Lacs Band of Ojibwe and all of its members, entities, directors, officers, assigns, lenders, agents and employees from any claims, liens, charges (including attorneys' fees), or encumbrances (including but not limited to mechanic's liens or bond claims) in connection with the performance of the Work. This indemnification shall not include instances where the Owner has failed to make payments when required under the Contract Documents. The Owner shall be entitled to recover from the Contractor all costs and expenses incurred in enforcing this Agreement, including attorneys' fees. Upon request of the Owner, the Contractor shall within 60 days remove any liens filed against the Owner or its property. If the Contractor fails to remove the liens, then the Owner is authorized to remove or satisfy any such liens, and the Contractor shall pay to the Owner all costs and damages incurred. The Contractor is not required to insure over the indemnity obligations to the extent such obligations are imposed in this subsection (C).

Section 14

BONDING REQUIREMENT

a. In construction contracts that are federally funded or deemed commercial, bonding is required. These types of contracts shall demand a performance bond of not less than twenty percent (20%) of the total contract price, but not to exceed \$500,000.00. A performance

bond requirement is to ensure that, if a contractor defaults, the Band may request that the surety pay the expenses incurred to complete the construction contract.

b. In addition, all construction contracts identified as federally funded or commercial shall be covered by a payment bond equal to one payment installment to cover subcontractors/suppliers as determined by the Contracting Officer or his agents. The payment bond must contain language stating that if the contractor fails to make a payment to its subcontractors/suppliers, the surety will make the necessary payment.

c. For all Band funded residential construction projects, a performance bond is required for contracts in excess of \$50,000.00. The performance bond shall be at a minimum twenty (20%) percent of the contract price, but not in excess of \$500,000.00.

See Miller Act, 40 U.S.C. 3131 – 3134. See also 7 MLBSA 17 (amended Oct. 14, 2005).

Section 15

CONTRACTOR'S LIABILITY INSURANCE

(A) The Contractor shall purchase and maintain from a state authorized company such insurance as will protect the Contractor, defined as the business owner and personnel, from such claims set forth below and for which the Contractor may be legally liable:

- (1) claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;
- (2) claims for damages because of bodily injury, sickness, disease, or death of the Contractor's employees;
- (3) claims for damages because of bodily injury, sickness, or death of any person other than the Contractor's employees;
- (4) claims for damages insured by usual personal injury liability coverage;
- (5) claims for damages, other than to the Work itself because of destruction of tangible property, including loss of use.
- (6) claims for damages because of bodily injury, death of a person or property damage arising out of use of a motor vehicle;
- (7) claims for bodily injury or property damage arising out of completed operations; and
- (8) claims involving contractual liability insurance applicable to the Contractor's obligations under Indemnification subsection (A).

(B) The insurance required by this section shall be written for coverage seen in subsection (C) or otherwise as required by law, whichever coverage is greater. Coverage, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until either the date when coverage ends or one year after project completion whichever is later.

(C) The insurance provided by the Contractor shall be written for not less than the following, or greater if required by law: Workers' Compensation - (Policy to include a waiver of subrogation in favor of the Owner.) Employer's Liability – Bodily injury by accident - \$500,000 each accident; bodily injury by disease - \$500,000 contract limit; bodily injury by disease - \$500,000 each employee. Commercial General Liability – (without limit to Premises Operations; Independent Contractors; Contractual Liability; Products and Completed Operations; Explosion, Collapse and Underground Liability ("XCU"); Broad Form Property Personal Injury and Advertising Liability (employment exclusion deleted; Incidental Medical Malpractice; Amendment of Pollution Exclusion-hostile fire; Cross-liability and severability of interest; Minimum Coverage \$1,000,000 C.S.L. Commercial Automobile Coverage \$1,000,000 D.S.L.

All of the above insurance shall be on an occurrence policy form. The Contractor shall maintain the required insurance continuously before commencing work to a period of at least twelve months after final completion. The Contractor's Contractual Liability Insurance shall cover the Contractor's obligations under Indemnification subparagraph (1) and any other contractual defense or indemnity obligation of the Contractor under this contract.

(D) The Contractor shall not allow insurance required by this Agreement to lapse, be cancelled, be reduced in limits or coverage, non-renewed, materially changed nor have restrictive modifications added during the life of the Agreement. All insurance policies and certificates of insurance shall contain a provision that afforded coverage shall not be cancelled, reduced in limits of coverage, materially changed, or have restrictive modifications added, without sixty (60) days prior written notice to the Owner. Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to the commencement of the Work. Failure of the Owner to object to a lack of a Certificate of Insurance or to the coverages indicated thereon or provided by the Contractor shall not constitute a waiver by the Owner of any of the Contractor's obligations. If insurance coverage is required to remain in force after final payment and is reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the close-out documentation. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, shall be furnished by the Contractor to the Owner with reasonable promptness.

(E) Commercial General Liability insurance required to be provided by the Contractor shall include the Owner as a named additional insured using ISO Form 2010. Policies for such insurance shall provide that such insurance is primary.

(F) In the event the Contractor fails to procure or maintain any insurance coverage required under this Agreement, the Owner may either purchase such coverage and deduct the cost thereof from any monies due to the Contractor, or suspend/terminate this contract.

(G) Compliance by the Contractor with the foregoing insurance requirements shall not relieve it from liability for amounts in excess of the limits of insurance.

(H) The Contractor and any of its subcontractors, sub-subcontractors, agents and employees shall waive any of their subrogation rights on their Workers' Compensation Policy in favor of the Owner. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though they would otherwise have a duty of indemnification, did not pay the insurance premium and irrespective of an insurable interest.

Section 16

WAGES, HOURS, AND SAFETY

(A) Labor Standards, Hours and Wages

All contracts in excess of \$5,000, related to the Work and involving employment for construction must comply with federal and state labor laws, wherever applicable. Specifically, contractors, subcontractors and other contract parties shall comply with the Contract Work Hours and Safety Standards Act (CWHSSA) (40 U.S.C. § 3701 *et seq.*), the Fair Labor Standards Act (FLSA) of 1938 (29 U.S.C. § 201 *et seq.*) and the Americans with Disabilities Act (ADA) (42 U.S.C. § 12101) *whenever Federal dollars are used in the construction contract process.*

(1) Under the requirements of Subsection (A), each contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work day of eight (8) hours and a standard work week of forty (40) hours. Work in excess of the standard work day or work week is permissible provided that the worker is compensated at a rate of not less than one and one half (1 ½) times the basic rate of pay for all hours worked in excess of eight (8) hours in a calendar day or forty (40) hours in the work week. The Act is applicable to construction work and provides that no laborer or mechanic shall be required to work in surroundings or under conditions which are unsanitary, hazardous, or dangerous to health and safety as determined under construction, safety and health standards promulgated by the Secretary of Labor. *See 7 MLBSA § 19(e).*

(2) All construction contracts, regardless of the source of the contract's funding, must comply with the Davis-Bacon Act (40 U.S.C. § 276(a) *et seq.*). Under the Act, laborers and mechanics must be paid no less

than the minimum wage as determined by the Secretary of Labor. All contracts over \$75,000.00, regardless of funding, must comply with COMMUNITY DEVELOPMENT COMMISSIONER'S ORDER 001-06, dated October 30, 2005.

(3) Every contractor and subcontractor, regardless of the source of the contract's funding, will be prohibited from inducing a person employed in the construction, prosecution, completion or repair of any public works project to give up any compensation to which they are entitled in exchange for the award of any Band construction contract. *See* Copeland "Anti-Kickback Act" (40 U.S.C. § 276(c)). **The Mille Lacs Band will prosecute and report all suspected or reported violations to appropriate law enforcement officials.** *See* 7 MLBSA § 19(c).

(B) Environmental Compliance

(1) Contracts in excess of \$10,000.00 shall require compliance with all codes of federal regulations and all applicable standards regarding environmental protections. **Violations and suspected violations will be reported by the Owner to the BIA and the EPA.**

(2) In addition to the requirement set forth in subsection (1), contracts and subcontracts in excess of \$100,000.00 require compliance with all applicable standards or requirements issued under the Clean Air Act (42 U.S.C. § 7401-7661 *et seq.*). Contracts in excess of \$100,000.00 must also comply with the Clean Water Act (33 U.S.C. § 1251) and United States' Executive Order 11738. United States' Executive Order 11738 is a declaration that governs the administration of the Clean Air Act in connection with federal grant construction projects. **This Executive Order requires the reporting of violations by the Owner to the grantor agency.** *See also* 7 MLBSA § 19(h).

(3) Compliance for all Contracts shall be required regarding mandatory standards and policies for energy efficiency requirements under the Energy Policy and Conservation Act (42 U.S.C. § 6201 *et seq.*)

(4) In addition, all contracts with the Band as the Owner shall comply with Tribal Law regarding protection of Tribal Cultural Resources (10 MLBSA § 2-5, 301-313) and Environmental Law (11 MLBSA § 103-123). No contractor or subcontractor shall be permitted to use hazardous materials in their construction efforts. Hazardous materials shall be defined as asbestos, toxic chemicals, waste, acids, alkalis, irritants, contaminants or other pollutants.

(C) Construction Compliance

(1) The contractor, subcontractor, agents and employees associated with the Work, shall comply with the Fair and Equitable Housing Act (42 U.S.C. § 3601 *et seq.*) as well as the Equal Credit Opportunity Act (15 U.S.C. § 1691). Compliance shall be required for minimum wage and maximum labor hours, "in any agreement relating to a federal, state or agency financial assistance housing program." *See* FAIR AND EQUITABLE HOUSING ACT (42 U.S.C. § 3601 §§ 114.14).

(2) The contractor, subcontractor, agents and employees associated with the Work, shall comply with ISO Rules and the Federal Building Codes (10 C.F.R. § 434, 10 C.F.R. § 435). In addition, the contractor, subcontractor, agents and employees associated with the Work, shall comply with Minnesota state law regarding building codes. Contractors, subcontractors, employees and agents shall be responsible for compliance with the Administration of State Building Codes (MN Rules Chapters 1300.0100 – 1300.6300; 1303.1600; 1303.1900; 1305.0010- .7100; 1309.0010 -.0703), the Minnesota Plumbing Code (MN Rules Chapters 4715.0100 – 4715.6000) and the Minnesota Energy Code (MN Rules Chapters 7670.0100 – 7670.1115). Finally, the contractor, subcontractor, agents, employees and others associated with the Work, shall be responsible for familiarity and compliance with the International Building Codes (I.B.C. Rules 101.3 – 3401.3), the International Residential Codes (I.R.C. Rules R302 – P2902) and the International Fuel and Gas Codes (I.F.G.C. Rules 106.1 – 506.3 *et seq.*).

(3) Acceptance of Nonconforming Work. If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its

removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be affected whether or not final payment has been made.

Section 17

WARRANTIES

The Contractor shall provide to the Owner any commercial warranty normally offered to the public. The Owner will not accept delivery of supplies and equipment “as is” unless the Contracting Officer has previously agreed in writing to accept supplies in such condition. The Contractor shall comply with the Minnesota Statute on Warranties (MN STAT. § 327B.02, 327B.03) and Housing Warranties (MN STAT. § 327A.01 – 327A.05). In addition, the Contractor shall comply with Minnesota state law regarding contractor licensing (MN STAT. § 327B.04 – 327B.09). Finally, the Contractor shall comply with Band law regarding Commercial Practices (18 MLBSA § 1-10, 101-112, 301) and Procurement of Construction Contracts (7 MLBSA § 1-36).

Section 18

COVENANT AGAINST CONTINGENT FEES

The Contractor warrants that no person or selling agency has been retained to solicit or obtain this Contract upon an agreement or understanding for a commission, brokerage or contingent fee, except a bona fide employee or bona fide established selling agent maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty, the Band shall have the right to terminate the Contract without liability and separate from the termination sections listed previously in this Contract. In this instance, the Band shall be able to deduct from the contract sum or otherwise recover the full amount of such commission.

Section 19

PATENTS AND COPYRIGHTS

This Contract is subject to all Mille Lacs Band requirements and regulations pertaining to reporting and copyright/patent rights under any contract for research, development, experiments, or demonstration work, and with respect to any discovery or invention which arises in the course of such contract. *See* 7 MLBSA § 19(f).

Section 20

INDIAN PREFERENCE

(A) A contractor shall give preferential employment under the contract, including subcontracts, to Band members and qualified Indians. Qualified Indians are persons defined under 25 C.F.R. § 273.2(j), see below, that meet posted or available job requirements. *Andrus v. Glover Construction Co.*, 446 U.S. 608 (1980) (footnote 3, citing 20 BIAM Bull. 1 (March 3, 1976)); *See also* 25 C.F.R. § 162.5a (1978); 41 C.F.R. § 14H-3.215-70 (1977).

An Indian is defined under the Indian Self-Determination and Education Assistance Act as a person who is a member of an Indian tribe. 25 C.F.R. § 273.2(j). The Act also defines Indian tribes as, “any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act (85 Stat. 688), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.” 25 C.F.R. § 273.2(g).

Contractor shall also provide employment and training opportunities to Indians regardless of age, religion or sex that are not fully qualified to perform under the contract where such would be consistent with contract performance. The contractor shall comply with all Indian preference requirements established by the Mille Lacs Band. Failure to

comply with these requirements may lead to termination for cause under section 8 of this contract. *See* 18 MLBSA § 401-428; 7 MLBSA § 21-24; *see also* INDIAN SELF-DETERMINATION AND EDUCATION ASSISTANCE ACT, 25 C.F.R. § 273.45; *see also* Housing and Urban Development (HUD) Act of 1968 (12 U.S.C. § 1701(3) and 25 C.F.R. § 135).

(B) Indian Preference shall mean awarding a contract or a subcontract with a priority first given to qualified Mille Lacs Band Members. The second priority shall be given to qualified members of other federally recognized Indian tribes. The third priority will be given to all other non-Indian persons. *See* 25 U.S.C. § 450e; *See also* MLB EXECUTIVE ORDER 122-97, August 19, 1997.

(C) If a contractor or any of its subcontractors are unable to fill employment openings after giving full consideration to Indians as required in subsection (A), these employment openings may then be filled by other persons under the conditions set forth in the Equal Employment Opportunity clause of the contract. The contractor agrees to include this clause or one similar in all subcontracts issued under the contract.

(D) Indian Preference shall also mean that contracts bid by Band member contractors that are within 10% of the lowest competitive bid shall be given the opportunity to negotiate an acceptable bid. *See* 25 U.S.C. § 450e.

Section 21

EQUAL OPPORTUNITY

During the performance of a contract and after complying with the Indian Employment Preference clause of the contract the contractor agrees as follows:

(A) The contractor will not discriminate against any employee or applicant for employment because of race, age, religion or sex. The contractor will take affirmative action that applicants are employed and that employees are treated during employment without regard to their race, age, religion or sex. Such action shall include, but not be limited to the following: Employment upgrading; demotion or transfer; layoff or termination; rates of pay or other forms of competition.

(B) The contractor will, in all solicitation or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, age, religion or sex.

(C) The contractor will include provisions of these sections in every subcontract or purchase order so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Mille Lacs Band may direct to enforce such provisions, including sanctions for non-compliance. *See* Indian Self-Determination Act (25 C.F.R. § 450e). If the contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction, the contractor *may request* the Mille Lacs Band to enter such litigation to protect the interest of the Mille Lacs Band. However, nothing in this paragraph shall be construed as a waiver of sovereign immunity of the Mille Lacs Band of Ojibwe in any court of competent jurisdiction.

(D) If no Indian business is available under the conditions of subsection (B), then the contractor agrees to accomplish the maximum amount of subcontracting with small or minority businesses if available.

Section 22

USE OF INDIAN BUSINESSES

(A) As used in this section, the term “Indian Businesses” means Indian organizations or an Indian owned economic enterprise as defined in the code of Federal Regulations or the laws of the Mille Lacs Band. *See* INDIAN BUSINESS DEVELOPMENT PROGRAM (25 C.F.R. § 286.1 – 286.22).

(B) The contractor agrees to give preference to qualified Indian businesses in the awarding of any subcontracts entered into under this contract. The contractor shall comply with any preference requirements regarding Indian businesses established by the Mille Lacs Band.

Section 23

BUY INDIAN PROVISIONS

All contractors and subcontractors who conduct business on lands under the jurisdictions of the Mille Lacs Band of Ojibwe pursuant to a contract or subcontract with the Band shall comply with the provisions of the Buy Indian Act (25 U.S.C. § 47).

Section 24

ASSIGNMENTS

No contract or subcontract awarded by the Mille Lacs Band of Ojibwe or any of the rights or interests or obligations therein may be assigned without the written approval of the Contracting Officer.

Section 25

TAXES

- A) The Owner is exempt from Minnesota State Sales Tax. For the purchase of supplies for construction, the Owner shall be the consumer and the state tax exemption will apply. The Owner shall provide the successful Contractors with a copy of their exemption certificate. Contractors must supply this copy when purchasing materials for construction, as well as Form ST8TG from the Minnesota Department of Revenue. *See also* MN STAT § 297.71-.74. Once the Contractor completes the purchase, the Contractor shall supply the Owner with copies of the Form ST8TG and other documentation of material costs. This exemption does not apply for the purchase of materials in road construction. 22 MLBSA § 508.
- B) The Administrative Policy Board may assess an Employment Rights Fee for the following:
 - 1) Contractors and subcontractors receiving contracts of \$100,000.00 or more shall pay 0.5% of the total contract sum pursuant to 22 MLBSA § 601. *See also* 18 MLBSA § 417.
- C) Contractor must also comply with the following:
 - 1) The Contractor has met the hiring goals of the TERO Compliance Officer, or
 - 2) The TERO Compliance Officer determines that the Contractor has made a substantial effort to train and employ Indian workers. 18 MLBSA § 401-428.

Section 26

UTILITIES

Contractors shall pay utility bills associated with the work at the construction site until the Contract has been closed out. The contract will be deemed finished and closed out when all inspections have been done, including but not limited to the, Certificate of Occupancy, keys are turned in to CMD Project Management Staff and all punch list items completed.

Section 27

AUDIT

- A) To the extent required by law, the contractor agrees that the Mille Lacs Band, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purpose of making audits, examination, excerpts and transcriptions. The Contractors shall maintain all records kept in the normal course of business for three years after the Mille Lacs Band makes final payments and all other pending matters are closed.
- B) In addition, for the sake of potential audits, please include documentation of all physical changes to the Work in the project's close-out documentation.

Section 28

AMENDMENT

This Contract may be amended or modified only by a written instrument, added as an addendum and consecutively numbered. Each addendum must be signed by the parties, and approved, if necessary, by the Mille Lacs Band, through the Mille Lacs Band of Ojibwe's Band Assembly.

Section 29

SEVERABILITY

If any provision of this contract or its application to the Owner and the Contractor is held invalid, the remainder of the contract and the application of other provisions to the Owner and the Contractor shall not be affected.

Section 30

RATIFICATION

This contract is effective and enforceable once it is finally ratified by the Band Assembly pursuant to 3 MLBSA § 2(f) cited below.

The Band Assembly shall have power:

(f) To ratify agreements, contracts, cooperative and reciprocity agreements and memoranda of understanding.

Section 31

SOVEREIGNTY AND WAIVER OF RIGHTS

Any waiver regarding this contract must be explicit, written and authorized by the Owner; nor will provisions in § 12 of this contract waive the Sovereign Immunity of the Mille Lacs Band of Ojibwe. Furthermore, claims beyond the scope of this Contract will not be permitted. Injunctive relief is an acceptable alternative. This contract will not govern any separate bonding agreement. Nothing else in this contract shall be construed as a waiver of sovereign immunity of the Mille Lacs Band of Ojibwe in the Court of Central Jurisdiction. *See 2 MLBSA § 5.* Nothing in this contract shall be construed as a waiver of sovereign immunity of the Mille Lacs Band of Ojibwe in any other court of competent jurisdiction. *See 2 MLBSA § 5.* Any waiver of rights by the Owner, under this Contract, in one single instance, does not create a continuous and overall waiver of rights. *See 2 MLBSA § 5.*

Section 32

ENTIRE AGREEMENT

(A) This Contract, including Forms and Addenda, constitutes the entire agreement between the parties regarding this subject matter. No representations have been made by any party, or any agent of any party, other than the terms and conditions set forth in this document. All prior and contemporaneous conversations, possible and alleged agreements, representations, covenants or omissions concerning the subject matter are void and have not been relied upon in any way by the Owner and the Contractor.

(B) The terms and conditions of this Contract are contractual in nature, and not a mere recital. This Contract shall constitute a legal, valid, and binding obligation of the parties, enforceable in accordance with its terms, and shall inure to the benefit of the parties.

This Contract is entered into as of the day and year first written above and is executed in at least three (3) original copies, of which one is to be delivered to the Contractor, and the remainder to the Owner.

IN WITNESS WHEREOF, we, the undersigned, have executed this Contract on the dates indicated below.

Dated: _____ By: _____
Commissioner of Community Development

Contractor: _____

Dated: _____ By: _____
Contractor or his/her Representative

OMB approval: _____ Dated: _____

OSG approval: _____ Dated: _____

RATIFICATION

Pursuant to the provisions of 3 MLBSA §2(f), this Contract was presented to the Band Assembly and is ratified on _____, 20__.

By: _____
Sheldon Boyd
Speaker of the Assembly

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ADDENDUM TO CONTRACT

The Mille Lacs Band of Ojibwe Community Development and the Contractor, _____ agree to the following addendum to the Mille Lacs Band of Ojibwe Construction/Service Contract.

DATE: _____

PROJECT NAME AND NO.: _____

CONTRACTOR NAME AND ADDRESS: _____

SUBCONTRACTOR (IF APPLICABLE): _____

DESCRIPTION OF WORK: _____

VENDOR NO: _____ OBLIGATION NO.: _____
ACCOUNT NUMBER FOR PROJECT: _____

PRICE FOR MATERIALS (if applicable): _____

CONTRACT SUM \$ _____

ADDENDUM \$ _____

FINAL CONTRACT \$ _____

This addendum constitutes the entire addendum agreement between the parties.

Commissioner of
Community Development

_____, Contractor/Contractor's
Representative

OMB _____

Date: _____

Solicitor General's Office _____

Date: _____

APB _____

Date: _____

Band Assembly _____

Date: _____

LEGAL NOTICE FORM

DATE: _____

CONTRACTOR NAME AND ADDRESS: _____

SUBCONTRACTOR NAME AND ADDRESS (if applicable): _____

INFORMATION REQUIRING LEGAL NOTICE: _____

INFORMATION (before change, if applicable): _____

INFORMATION (after change, if applicable): _____

SENDER'S NAME AND TITLE: _____

METHOD OF NOTICE: _____

DISPUTE CLAIM FORM

Claims must be made within twenty-one (21) business days of the occurrence or condition giving rise to such event (whichever is later)

DATE: _____

PROJECT NAME/NO.: _____

CONTRACTOR (name and address): _____

SUBCONTRACTOR (name and address, if applicable): _____

GENERAL NATURE OF CLAIM (Provide a short statement of the claim): _____

FACTS (provide description of events regarding dispute; provide names, phone numbers and personnel designation where applicable; attach separate sheet if needed) _____

DESIRED REMEDY AND REASONS (attach separate sheet if needed): _____

SECTION VI – ADMINISTRATIVE REQUIREMENTS

Bidding Requirements and Contract Forms

1. PROJECT MANAGEMENT AND COORDINATION

- a. Prior to starting Work, the Contractor shall submit the following information to CMD Project Coordinator: Project Schedule, Copies of all Building Permits, Bond (if required), and Approved TERO plan in place. Failure to have any of this documentation turned in will lead to immediate shut-down of the Work.
- b. Verify layout information shown on Drawings, in relation to property survey and existing benchmarks, before laying out the Work.
- c. Coordinate construction to ensure efficient and orderly execution of each part of the Work.
- d. Progress meetings will be held at Project site periodically. Notify CMD Project Management staff (hereafter referred to as "Owner"), (and Architect, if applicable) of meeting dates a minimum of 48 hours prior. Each subcontractor or other entity concerned with current progress or involved with planning or coordination of future activities, shall attend. Meeting time/date/location to be determined by Contractor or in some cases, CMD Project Management staff.
 - i. Prepare minutes of each meeting and distribute to parties present.

2. CONSTRUCTION SCHEDULE

- a. Prepare a horizontal bar-chart construction schedule. Schedule will be submitted to CMD Project Management staff (hereafter referred to as "Owner") prior to commencement of any work on-site. Provide a separate time bar for each activity and a vertical line to identify the first workday of each week. Use same breakdown of Work indicated in the Schedule of Values. As Work progresses, mark each bar to indicate actual completion.
 - i. Submit with signed contract.
 - ii. Coordinate each element with other activities. Show each activity in proper sequence. Indicate sequences necessary for completion of related Work.
 - iii. Indicate Substantial Completion and allow time for Inspection procedures necessary for certifying Substantial Completion.
 - iv. Schedule Distribution: Distribute copies to Owner, (Architect, if applicable), subcontractors, and parties required to comply with dates.
 - v. Updating: Revise the schedule bi-weekly, after each meeting or activity where revisions have been made - whichever is most recent. Distribute revised copies to Owner, (Architect, if applicable), subcontractors, and parties required to comply with dates. Any/all modifications to the original schedule must be submitted, in writing, to CMD Project Management staff as they occur.

3. SUBMITTAL PROCEDURES

- a. Coordinate submittal preparation with construction schedule, fabrication lead-times, other submittals, and activities that require sequential operations.
 - i. No extension of Contract Time will be authorized due to failure to transmit submittals in time to permit processing sufficiently in advance of when materials are required in the Work.
 - ii. Owner will not accept submittals from sources other than Contractor.
 - iii. Prepare submittals by placing a permanent label on each for identification. Provide a 4- by 5-inch (100- by 125-mm) space on the label or beside title block to record review and approval markings and action taken. Include the following information on the label:
 - a. Project name.
 - b. Date.
 - c. Name and address of Contractor.
 - d. Name and address of subcontractor or supplier.

- e. Number and title of appropriate Specification Section.
 - f. Contractor's certification that materials comply with specified requirements.
- b. Coordinate each submittal with other submittals and with work that does not require submittals.
 - c. Product Data: Mark each copy to show applicable choices and options. Include the following:
 - i. Data indicating compliance with specified standards and requirements.
 - ii. Notation of coordination requirements.
 - iii. For equipment data, include rated capacities, dimensions, weights, required clearances, and furnished specialties and accessories.

4. SHOP DRAWINGS

- a. Submit newly prepared information drawn to scale. Do not reproduce Contract Documents or copy standard information. Submit 1 reproducible print and 1 blue- or black-line print on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (762 by 1067 mm). Owner will return the reproducible print. Include the following:
 - i. Dimensions, profiles, methods of attachment, coordination with adjoining work, large scale details, and other information, as appropriate for the Work.
 - ii. Identification of products and materials.
 - iii. Notation of coordination requirements.
 - iv. Notation of dimensions established by field measurement.
 - v. Identification of deviations from Contract Documents.

5. SAMPLES

- a. Submit Samples finished as specified and identical with the material proposed. Where variations are inherent in the material, submit sufficient units to show limits of the variations. Include product name or name of the manufacturer.

6. CHANGE ORDER PROCESS

- a. Any/all necessary changes to the original scope of work must be submitted, in writing, to CMD Project Management staff prior to any work be done. Modifications made to the scope of work not previously identified and authorized will not be subject to additional compensation.
- b. Change order pricing will be submitted with labor and materials listed separately. A maximum of 10% mark-up will be allowed on materials.
- c. **Any change order that results in an increase in the contract amount will require a properly executed Addendum to the Contract. Additional work should not begin until this is executed by both the contractor and the Commissioner of Community Development.**

7. LIEN WAIVERS AND MONTHLY PAYMENTS

- a) Billing will be submitted by the contractor to CMD on a monthly basis.
- b) All invoices must be submitted on CMD monthly billing forms and be accompanied by CMD lien waivers (full, partial, or conditional) for the present draw request, and satisfied lien waivers partial or full from previous billing. Copies of building inspection reports will also need to be submitted with the current draw for work shown as complete on the present draw.

END OF SECTION

SECTION VII – BUILDING CODES/INSPECTIONS

Bidding Requirements and Contract Forms

1. BUILDING CODES

- a. All residential construction projects will follow all codes within the International Residential Code **2018** (IRC)
- b. All commercial construction projects will follow all codes within the International Building Code **2018** (IBC).
- c. All construction projects will follow all codes within the State Energy Code of Minnesota Rule, Chapter 1322 and the Commercial State Energy Code, Chapter 1323.
- d. All mechanical projects will follow the 2018 International Mechanical Code (IMC) with State of Minnesota Amendments.
- e. All Plumbing projects will follow all current State of Minnesota applicable codes.

2. INSPECTIONS:

- a. Mille Lacs Band of Ojibwe Building Permits:

Building Permit Fee Schedule:

- Projects valued from \$1.00 - \$25,000. Permit costs \$150.00
 - Projects valued from \$25,001.00 - \$75,000. Permit fee \$250.00
 - Projects valued from \$75,001.00 - \$125,000. Permit fee \$350.00
 - Projects valued from \$125,001.00 - \$200,000. Permit fee \$450.00
 - Projects valued from \$200,001.00 - \$350,000. Permit fee \$500.00
 - Projects valued from \$350,001.00 - \$500,000. Permit fee \$550.00
 - Projects valued from \$500,001.00 - \$750,000. Permit fee \$600.00
 - Projects valued from \$750,001.00 - \$1,000,000. Permit fee \$650.00
 - Projects valued from \$1,000,001.00 - \$1,500,000. Permit fee \$700.00
 - Projects valued from \$1,500,001.00 - \$2,000,000. Permit fee \$750.00
 - Projects valued from \$2,000,001.00 - \$3,000,000. Permit fee \$950.00
 - Projects valued from \$3,000,001.00 - \$5,000,000. Permit fee \$1,000.00
 - Projects valued from \$5,000,001.00 - \$10,000,000. Permit fee \$1,500.00
 - Projects valued over \$10,000,000. Permit fee \$3,000.00
- ✓ Contractors will be responsible for obtaining any county and/or State permits required for conducting work in addition to the Mille Lacs Band of Ojibwe Permit.
- b. Public Works Inspections are provided to contractor at no cost.
 - i. Required inspections: Water hook-ups, Sewer hook-ups.
 - ii. 48 hours prior notice is required. Call 320-532-7430 to schedule an inspection.
 - c. Quality Control
 - i. CMD Project Management staff will be conducting all quality control inspections. Contact Project Coordinator to schedule.
 - ii. Punch List walk-throughs need to be coordinated with the Project Coordinator at least 48 hrs prior. For further instructions regarding the MLB CMD Punch List Process, consult with CMD Project Management Staff.
 - iii. Final Acceptance / Turnover meeting: Contractor shall schedule final acceptance meeting, at the time of Punch List scheduling, with CMD Project Management staff. This meeting time will be used to verify punchlist item completion, and allow opportunity for MLBO Housing Authority to review the condition of the home. Any quality issues identified during this meeting will be corrected by the Contractor. If needed, re-schedule a second acceptance meeting.
 - iv. Specific pre-installation inspections may be required at the discretion of CMD Project Management Staff for:
 1. Concrete installation
 2. Window installation
 3. Electrical rough-ins
 4. Painting installation
 5. Flooring installation

END OF SECTION

SECTION VIII – FEES, FINES & REQUIRED INSPECTIONS

Bidding Requirements and Contract Forms

1. BUILDING INSPECTION FEES:

Any contractor conducting work with the Mille Lacs Band of Ojibwe will be required to apply for a building permit through the Community Development inspection office, even if another jurisdiction also requires a permit and inspection. If an outside jurisdiction does require a permit Contractor must obtain Letter of Protest from CMD Project Management staff to submit with the permit application.

MLB Building Permit Fee Schedule:

- Projects valued from \$1.00 - \$25,000. Permit costs \$150.00
- Projects valued from \$25,001.00 - \$75,000. Permit fee \$250.00
- Projects valued from \$75,001.00 - \$125,000. Permit fee \$350.00
- Projects valued from \$125,001.00 - \$200,000. Permit fee \$450.00
- Projects valued from \$200,001.00 - \$350,000. Permit fee \$500.00
- Projects valued from \$350,001.00 - \$500,000. Permit fee \$550.00
- Projects valued from \$500,001.00 - \$750,000. Permit fee \$600.00
- Projects valued from \$750,001.00 - \$1,000,000. Permit fee \$650.00
- Projects valued from \$1,000,001.00 - \$1,500,000. Permit fee \$700.00
- Projects valued from \$1,500,001.00 - \$2,000,000. Permit fee \$750.00
- Projects valued from \$2,000,001.00 - \$3,000,000. Permit fee \$950.00
- Projects valued from \$3,000,001.00 - \$5,000,000. Permit fee \$1,000.00
- Projects valued from \$5,000,001.00 - \$10,000,000. Permit fee \$1,500.00
- Projects valued over \$10,000,000. Permit fee \$3,000.00

1st re-inspection:	Free
2nd re-inspection:	\$100.00
3rd re-inspection and thereafter:	\$350.00
Emergency Inspection:	\$175.00
<i>– defined as less than 24 hours notice</i>	
Not ready for called inspection:	\$500.00
No Show for inspection:	\$500.00
Concealment of work prior to inspection:	\$500.00
Work with no MLBO permit:	\$1,000.00

2. SCHEDULE OF REQUIRED INSPECTIONS (if applicable to the nature of the Work)

- A. Footings
- B. Foundation
- C. All Cast-In-Place Concrete Flatwork
- D. Radon Reduction
- E. Underground Plumbing / Mechanical
- F. Framing
- G. Plumbing Rough-In
- H. Mechanical Rough-in
- I. Electrical Rough-in (State of MN & Prior to Framing Inspection)
- J. Roofing Dry-In
- K. House Wrap
- L. Siding
- M. Insulation
- N. Windows and Doors
- O. Plumbing Final
- P. Mechanical Final
- Q. Smoke and Carbon Monoxide Detectors
- R. Electrical Final (State)
- S. Building Final Inspection

END OF SECTION

END BIDDING REQUIREMENTS AND CONTRACT FORM

SECTION 00 96 00 – SUBSTITUTION REQUEST FORM

To: **Busch Architects, Inc.**
 310 4th Avenue South
 Suite 1000
 Minneapolis, MN 55415

SECTION #	PARA#	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION
-----------	-------	-------------------	-----------------------

REASON FOR SUBSTITUTION:

ATTACH COMPLETE TECHNICAL DATA, LITERATURE AND SAMPLE IF APPLICABLE

1. Does proposed substitution fail to satisfy, in any respect, characteristics specified for original products?
 Yes () No ()
2. Does the substitution affect dimensions shown on drawings? Yes () No ()
3. Does substitution affect other trades? Yes () No ()
4. Does the warranty differ from that specified? Yes () No ()
5. Does the substitution affect cost to Owner? Yes () No ()
 If so, how much? Add\$_____ Deduct \$_____
6. If you indicated "Yes" to any of the items above, attach through explanation on your Company letterhead as follows:
 - a. Explain any differences between proposed substitution and specified product.
 - b. Summarize experience with product and manufacturer in Project area.

The undersigned states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item. The undersigned agrees that, if necessary, in the sole opinion of the Architect/Engineer, to make this products perform as intended all additional costs shall be paid by the contractor.

For use by Architect	
Submitted by:	Accepted:
Position:	Accepted as noted:
Company:	Not accepted:
Address:	Received past deadline:
Contractor Information	
Date:	Firm:
Telephone :	Email:
Signature:	Remarks:

SECTION 01 01 00 - SUMMARY OF THE WORK

PART I GENERAL

1.01 CONDITIONS OF THE CONTRACT

Requirements of Sections in Division 0 and Division 1 extend and apply to all work and material supplied by the Contractor, subcontractors, material suppliers, and equipment vendors and shall be included as part of each section of this Project Manual.

Where the term "include" is used under a description of the scope of work in subsequent Sections of this Project Manual, it shall be interpreted to mean items of work therein listed may be a part, but not necessarily the limit, of work required under that Section. The Contractor shall examine the Drawings and Specifications to determine the full scope of work required to comply with the intent of the Contract Documents.

1.02 SCOPE OF WORK

Work to be performed under this Contract shall be shown on the Drawings, defined in the Technical Sections of the Project Manual, and governed by the requirements stipulated in Division 0 and Division 1 as listed in the Table of Contents, and any addenda. It is the bidder's sole responsibility to verify that they have received all sheets of Drawings and Specifications. No claim for additional compensation will be allowed due to lack of complete information at time of bid.

- Scope of the project includes but is not limited to the following: Site improvements including perimeter security, access gate, paving, building protection, damaged cladding remediation. Interior renovations require the refinishing of floors, addition of a restroom and remodel of a separate restroom, office and mechanical room expansions, door replacements and infills, and mechanical and electrical updates.
- Completed project will include but is not limited to the following: Redefined and finished Training Room with kitchenette, new restroom, remodeled restroom with finishes and fixtures to match new restroom, new floor covering throughout finished spaces, door replacements throughout (interior and exterior), door infills with aluminum storefront glazing systems, new HVAC, new lighting, remodeled septic, site pavement, perimeter fencing, and site access gate.

Bids are to be received under a single Base Bid and any Alternate Bids which may be identified on the official Bid Forms issued by the Owner's Purchasing Agents. The Owner has the right to award Base Bid and any or all Alternates to the Base Bids in any order deemed acceptable by the Owner.

Equipment or work indicated on Plans to be "by Owner" or "N.I.C." is not to be in the bid for the construction contract. However, there may be work required to provide base construction or mounting devices, for work by others, which is to be part of the Contract.

1.03 FORM OF AGREEMENT

All work on this Project shall be awarded to a Prime Contractor as stipulated in this Project Manual. The Agreement for the work will be written on the MLBO Construction Contract.

1.04 START OF WORK

All products shall be ordered immediately upon award of the contracts. Fabricated items shall be scheduled to allow delivery and installation when related work is complete.

All work shall be substantially completed by the date indicated in the Invitation to Bid.

In no event shall work commence until all required insurance certificates, bonding and permits have been received and accepted by the owner. Furthermore, no contractor nor subcontractor shall commence work until their TERO plan has been approved by the TERO Director.

1.05 SUBSTANTIAL COMPLETION

The Architect will inspect the work to issue a **Certificate of Substantial Completion** and any related memorandum of incomplete or incorrect work which will allow Owner occupancy and full use of the renovated space.

1.06 USE OF SITE

The Contractor's operations and storage of materials and equipment shall be organized and secured to minimize establishment of an attractive nuisance and to prevent vandalism. The Contractor will assume the responsibility for protection of the work and any stored or stockpiled equipment and material.

The Contractor will designate and maintain, in coordination with the Owner, specific areas where material is to be stored and equipment set up. The Contractor will be required to insure that infringement on adjacent spaces is avoided during progress of the work and that damage occurring to adjacent spaces shall be corrected immediately at no additional cost to the Owner. The Contractor shall confine the operations within the property owned, to include any roads or drives through public thoroughfares. Any damage to adjacent property, public or private, shall be corrected to the satisfaction of the injured party at no additional cost to the Owner.

1.07 ARCHITECT AND CONSULTANTS

The Architect for the Project is **Busch Architects, Inc.**, 310 4th Avenue South, Suite 1000, Minneapolis, Minnesota, 55415. Telephone: (612) 333-2279.

Mechanical/Electrical Engineer is **Emaunelson-Podas, Inc.**, 7705 Bush Lake Road, Edina, MN 55439. Telephone: (952) 930-0050.

Civil Engineer is **Larson Engineering, Inc.**, 3524 Labore Road, White Bear Lake, MN 55110. Telephone: (651) 481-9120

Structural Engineer is **Meyer Borgman and Johnson**, 510 Marquette Ave. Unit 900, Minneapolis, MN 55402. Telephone: (612) 339-0713

1.08 PERMITS, FEES AND NOTICES

Building Permit. The General Contractor will secure and pay for all required building permits for the Project. The Contractor will not be allowed to commence work on the Project until all permits are received. Fees shall include the building permit fees, plan check fees, State surcharge, and other fees customarily charged for the building permit. The Contractor and all Subcontractors are to include permits and fees in their bids. Applicable permits include, but may not be limited to, general building, electrical, mechanical, plumbing, sewers, and work with-in street right-of-way.

Other Permits and Fees. Each contractor shall secure and pay for all other permits and governmental fees, licenses and inspections necessary for the proper execution of the Contract and which were legally required at the time the bids were received.

1.09 INSPECTION OF WORK OF OTHERS

Each Contractor shall inspect work of others which will receive or is adjacent to his Work before commencing his Work. Do not proceed until conditions which would result in a less than first class installation are satisfactorily corrected. Commencing work shall be constructed as acceptance of the work of others by the contractor as satisfactory to receive his Work.

1.10 INSPECTIONS AND TESTS

Where Contract Documents require inspections, tests or approvals of the Work to be made by an independent testing agency or laboratory or an independent professional consultant, the independent testing agency or laboratory or independent professional consultant shall be satisfactory to the Owner and the Architect.

End of Section

SECTION 01 10 00 - SUMMARY OF THE WORK

PART I GENERAL

1.01 CONDITIONS OF THE CONTRACT

Requirements of Sections in Division 0 and Division 1 extend and apply to all work and material supplied by the Contractor, subcontractors, material suppliers, and equipment vendors and shall be included as part of each section of this Project Manual.

Where the term "include" is used under a description of the scope of work in subsequent Sections of this Project Manual, it shall be interpreted to mean items of work therein listed may be a part, but not necessarily the limit, of work required under that Section. The Contractor shall examine the Drawings and Specifications to determine the full scope of work required to comply with the intent of the Contract Documents.

1.02 SCOPE OF WORK

Work to be performed under this Contract shall be shown on the Drawings, defined in the Technical Sections of the Project Manual, and governed by the requirements stipulated in Division 0 and Division 1 as listed in the Table of Contents, and any addenda. It is the bidder's sole responsibility to verify that they have received all sheets of Drawings and Specifications. No claim for additional compensation will be allowed due to lack of complete information at time of bid.

- Scope of the project includes but is not limited to the following: Site improvements including perimeter security, access gate, paving, building protection, damaged cladding remediation. Interior renovations require the refinishing of floors, addition of a restroom and remodel of a separate restroom, office and mechanical room expansions, door replacements and infills, and mechanical and electrical updates.
- Completed project will include but is not limited to the following: Redefined and finished Training Room with kitchenette, new restroom, remodeled restroom with finishes and fixtures to match new restroom, new floor covering throughout finished spaces, door replacements throughout (interior and exterior), door infills with aluminum storefront glazing systems, new HVAC, new lighting, remodeled septic, site pavement, perimeter fencing, and site access gate.

Bids are to be received under a single Base Bid and any Alternate Bids which may be identified on the official Bid Forms issued by the Owner's Purchasing Agents. The Owner has the right to award Base Bid and any or all Alternates to the Base Bids in any order deemed acceptable by the Owner.

Equipment or work indicated on Plans to be "by Owner" or "N.I.C." is not to be in the bid for the construction contract. However, there may be work required to provide base construction or mounting devices, for work by others, which is to be part of the Contract.

1.03 FORM OF AGREEMENT

All work on this Project shall be awarded to a Prime Contractor as stipulated in this Project Manual. The Agreement for the work will be written on the MLBO Construction Contract.

1.04 START OF WORK

All products shall be ordered immediately upon award of the contracts. Fabricated items shall be scheduled to allow delivery and installation when related work is complete.

All work shall be substantially completed by the date indicated in the Invitation to Bid.

In no event shall work commence until all required insurance certificates, bonding and permits have been received and accepted by the owner. Furthermore, no contractor nor subcontractor shall commence work until their TERO plan has been approved by the TERO Director.

1.05 SUBSTANTIAL COMPLETION

The Architect will inspect the work to issue a **Certificate of Substantial Completion** and any related memorandum of incomplete or incorrect work which will allow Owner occupancy and full use of the renovated space.

1.06 USE OF SITE

The Contractor's operations and storage of materials and equipment shall be organized and secured to minimize establishment of an attractive nuisance and to prevent vandalism. The Contractor will assume the responsibility for protection of the work and any stored or stockpiled equipment and material.

The Contractor will designate and maintain, in coordination with the Owner, specific areas where material is to be stored and equipment set up. The Contractor will be required to insure that infringement on adjacent spaces is avoided during progress of the work and that damage occurring to adjacent spaces shall be corrected immediately at no additional cost to the Owner. The Contractor shall confine the operations within the property owned, to include any roads or drives through public thoroughfares. Any damage to adjacent property, public or private, shall be corrected to the satisfaction of the injured party at no additional cost to the Owner.

1.07 ARCHITECT AND CONSULTANTS

The Architect for the Project is **Busch Architects, Inc.**, 310 4th Avenue South, Suite 1000, Minneapolis, Minnesota, 55415. Telephone: (612) 333-2279.

Mechanical/Electrical Engineer is **Emaunelson-Podas, Inc.**, 7705 Bush Lake Road, Edina, MN 55439. Telephone: (952) 930-0050.

Civil Engineer is **Larson Engineering, Inc.**, 3524 Labore Road, White Bear Lake, MN 55110. Telephone: (651) 481-9120

Structural Engineer is **Meyer Borgman and Johnson**, 510 Marquette Ave. Unit 900, Minneapolis, MN 55402. Telephone: (612) 339-0713

1.08 PERMITS, FEES AND NOTICES

Building Permit. The General Contractor will secure and pay for all required building permits for the Project. The Contractor will not be allowed to commence work on the Project until all permits are received. Fees shall include the building permit fees, plan check fees, State surcharge, and other fees customarily charged for the building permit. The Contractor and all Subcontractors are to include permits and fees in their bids. Applicable permits include, but may not be limited to, general building, electrical, mechanical, plumbing, sewers, and work with-in street right-of-way.

Other Permits and Fees. Each contractor shall secure and pay for all other permits and governmental fees, licenses and inspections necessary for the proper execution of the Contract and which were legally required at the time the bids were received.

1.09 INSPECTION OF WORK OF OTHERS

Each Contractor shall inspect work of others which will receive or is adjacent to his Work before commencing his Work. Do not proceed until conditions which would result in a less than first class installation are satisfactorily corrected. Commencing work shall be constructed as acceptance of the work of others by the contractor as satisfactory to receive his Work.

1.10 INSPECTIONS AND TESTS

Where Contract Documents require inspections, tests or approvals of the Work to be made by an independent testing agency or laboratory or an independent professional consultant, the independent testing agency or laboratory or independent professional consultant shall be satisfactory to the Owner and the Architect.

End of Section

SECTION 01 20 00 – PROJECT MEETINGS

1.01 RELATED SECTIONS

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this Section.

1.02 PRE-PROPOSAL MEETING AND SITE VISIT

A Pre-Proposal Meeting will be held. See Request for Proposal (RFP) for date, location, and additional information. The A/E shall record attendance and minutes. Written addenda based on comments and questions shall be distributed to all planholders.

1.03 SECTION INCLUDES

- A. Coordination
- B. Preconstruction conference
- C. Progress Meetings
- D. Pre- installation conferences

1.04 COORDINATION

The Prime Contractor and the successful Subcontractors will prepare and provide a detailed Project Schedule indicating the dates for the commencement and completion of the various stages of construction for review. The Schedule may be revised as required by the Owner, in accordance with conditions of the Project. The Owner reserves the right to direct the Contractor, without payment of additional compensation, to suspend, delay, accelerate, or reschedule from time to time the performance of the Contractor's work, as necessary to facilitate job progress.

Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

1.05 PRECONSTRUCTION CONFERENCE

Owner and Architect/Engineer will schedule a conference prior to commencement of construction.

Attendance Required: Owner, Architect/Engineer, Contractor, and Major Subcontractors.

Agenda:

1. Identification of Superintendents
2. Identification of Subcontractors and Suppliers
3. Owners' requirements.
4. Designation of personnel representing the parties in Contract and the Architect/Engineer.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal requests, change orders and contract closeout procedures.
6. Scheduling
7. Use of premises by Owner and Contractor.
8. Construction facilities and controls provided by the Owner.
9. Temporary utilities provided by the Owner.
10. Safety, security and housekeeping procedures.
11. Procedures for testing.
12. Procedures for maintaining record documents.

13. Requirements for start-up of equipment.
14. Inspection and acceptance of equipment put into service during construction.

1.06 PROGRESS MEETINGS

Progress meetings shall be scheduled at minimum bi-monthly intervals from the commencement of construction through substantial completion, and additional meetings may be scheduled if deemed necessary by Owner or Architect.

The Prime Contractor shall administer meetings throughout the progress of the Work, prepare agendas with copies for participants, preside at meetings, record minutes, and distribute copies within two days to Architect, engineering consultants, and Owner. The Prime Contractor shall be responsible for providing meeting notes to all other subcontractors under their contract.

Attendance Required: Job Superintendent, major Subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

1.07 PREINSTALLATION CONFERENCES

When required in individual specification Section, convene a preinstallation conference at work site prior to commencing work of the Section.

Require attendance of parties directly affecting, or affected by, work of the specific Section.

Notify Architect/Engineer and Owner seven (7) days in advance of meeting date.

Prepare agenda, preside at conference, record minutes, and distribute copies within two days after conference to participants, with two copies to Architect/Engineer.

Review conditions of installation, preparation and installation procedures, and coordination with related work

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

End of Section

SECTION 01 23 00 - ALTERNATES

1.01 GENERAL INFORMATION

Bidders shall submit bids for each item listed below. See Bid Form for additional information. The amount of each alternate shall be stipulated in the space provided below.

The Owner reserves the right to reject all alternates or accept any alternates in any order or combination.

The following descriptions of the alternates describe the extent of the Work in general and are not intended to be a complete tabulation of the Work which may be affected by the alternates. Bidders shall carefully examine the Contract Documents and satisfy themselves as to the exact extent of the Work affected by the alternates. Contractor will be required to coordinate the related work and modify surrounding work as required. Detailed requirements may be specified in the various Sections of the Specifications.

1.02 ALTERNATES

Description of Alternates:

All items below are add or deduct alternates. Alternate bids will be accepted or rejected in any order that the Owner deems satisfactory to meet the project requirements, with bid amounts to be added to or deducted from the Lump Sum Base Bid.

- 1. **Alternate Bid No. 1:** Provide double swing gate with locking mechanism in lieu of power pivot gate and gate operator.

Add Bid Alt. #1A Labor \$ _____

Add Bid Alt. #1A Material \$ _____

End of Section

SECTION 01 30 00 SUBMITTALS

PART 1 - GENERAL

1.01 RELATED SECTIONS

Drawings and general provision of the Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to the work of this section.

1.02 SECTION INCLUDES

- A. Submittals and timing.
- B. Certificates of Insurance.
- C. Performance and Payment Bonds.
- D. Submittal procedures.
- E. Construction progress schedules.
- F. Proposed products list.
- G. Shop Drawings.
- H. Product Data.
- I. Samples.
- J. Manufacturer's installation instructions.
- K. Manufacturer's certificates.
- L. Field samples.

1.03 SUBMITTALS AND TIMING

- A. During bidding period:
 - 1. Substitution requests
 - 2. Addenda.
- B. Upon Contract award:
 - 1. Contract.
- C. Within ten (10) days of Contract issue,
 - 1. TERO Plans
 - 2. Performance and Payment Bonds
 - 3. Certificates of Insurance
 - 4. Work to be performed by Contractor's own forces.
 - 5. Work to be sublet and list of proposed subcontractors and suppliers.
 - 6. Progress schedule.
 - 7. List of materials and equipment.
 - 8. Schedule of shop drawings.
 - 9. Schedule of values.
 - 10. Construction permits.
- D. During construction:
 - 1. Shop drawings, Product Data, Samples, Specification submittal records.
 - 2. Test results and certifications.
 - 3. Request for Project Review.
 - 4. Proposed Change Orders
 - 5. Application for partial payment.
 - include lien waivers, relevant inspections copies and certified payroll with each payment application
 - 6. An accurate, updated project schedule at each construction meeting.
 - 7. Guarantees.
- E. At completion
 - 1. "As-built" Record drawings.
 - 2. Operation and maintenance manuals.

3. Certificates Warranties and Bonds.
4. Certificate of Substantial completion.
5. Application and Invoice for final payment.
 - include final lien waivers, relevant inspections copies and TERO receipt with final payment application
6. Consent of Surety to Final Payment.
7. See Section 01700, Contract Closeout for additional items to be submitted.

1.04 PERFORMANCE AND PAYMENT BONDS

- A. As required by the Owner

1.05 CERTIFICATES OF INSURANCE

- A. As required by the Owner

1.06 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Architect/Engineer/Owner accepted form.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail numbers and specification number as appropriate.
- C. Apply Contractor's stamp signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work and Contract Documents.
- D. Schedule submittals to expedite the project, and deliver to the Architect/Engineer at business address. Coordinate submission of related items.
- E. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- F. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- G. Provide space for Contractor and Architect/Engineer review stamps.
- H. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report inability to comply with provisions.

1.07 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within ten (10) days of Contract issuance, Show date of substantial completion and final completion on the project schedule.
- B. Revise and resubmit an accurate and updated project schedule at each construction meeting.
- C. Submit revised schedules with each Application for payment, identifying changes since previous version.
- D. Submit a horizontal bar chart with separate line for each major section or Work or operation identifying the first day of each week.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates and duration.
- F. Indicate estimates percentage of completion for each item of work at each submission.
- G. Indicate submittal dates required for shop drawings, product data, samples and product delivery dates, including those furnished by Owner and under Allowances.
- H. The General Contractor shall coordinate all tasks and purchase of materials which have been indicated to be completed or supplied by the Owner. The Owner's tasks shall be indicated on the Construction Schedule.

1.08 SCHEDULE OF SHOP DRAWINGS

- A. Each Contractor shall prepare an estimate of shop drawings, product data and sample schedule and submit a digital copy, in PDF format, to the Architect for review and approval.
- B. Schedule shall list each shop drawings, item of product data and sample required for the project and shall indicate the date of final approval required so as to not delay the Work based on the Contractor's Progress Schedule, the time required for correction and resubmission including field measurements and rechecking by the Contractor and the estimated date of initial submission based on at least one resubmission and allowing a reasonable time for the Architects review and approval.
- C. The approved Schedule shall form the basis for the timing and submission of shop drawings, product data, and samples of the work.
- D. Should it become necessary as the Work progresses, the Contractor shall promptly revise the schedule to conform to the current status of the Work, and shall; furnish revised schedules to the Architect as noted above.

1.09 SHOP DRAWINGS AND PRODUCT DATA

- A. Shop Drawings and Product Data shall be submitted to the Architect by the Contractor and shall bear the Contractor's stamp of approval.
- B. Shop Drawings and Product Data shall be clearly identified according to the project, contract number, Contract, manufacturer, project manual section and item submitted. Any modification to or deviation from the requirements of the Contract Documents shall be clearly noted in writing.
- C. Shop drawings shall be submitted as a digital copy in PDF format to the Architect unless otherwise specified. Following review, the Architect/Engineer shall affix his/her stamp and note approval or rejection along with appropriate comments. Copies of poor quality, too dark, or in the Architect's opinion, illegible, will be returned without checking.
- D. Submit Product Data digitally otherwise specified.
- F. Upon review and approval, the Architect/Engineer will submit Shop Drawings for Owner's Project Manager's approval. Copies returned "resubmit" or "disapproved" shall have the original drawing corrected and be resubmitted to the Architect in the format indicated above.

1.10 SAMPLES

- A. Submit samples for selection of finishes in size/quantity per specification section.
- B. Note: Architect and Owner will act on color, finish, texture, and pattern selections within reasonable time (30 days minimum) after all sample palettes have been received.
- C. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Submit samples of finishes from the full range of manufacturer's standard colors, textures, and patterns for Architect/Engineer selection.
- E. Include identification on each sample, with full project identification.
- F. Submit the number of samples specified in individual specification sections; one of which will be retained by the Architect/Engineer.
- G. Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.11 MANUFACTURER'S INSTALLATION INSTRUCTIONS

- A. When specified in individual specification sections, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect/Engineer.

1.13 FIELD SAMPLES

A. Provide field samples of finishes as required by individual specification section. Install sample complete and finished. Acceptable samples in place may be retained in the completed Work.

1.14 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Provide operating instruction data and maintenance manuals in accordance with Section 01700. Submit two (2) copies of the manuals to the Architect for forwarding to the Owner – One hard copy (paper) and One digital copy (pdf).

B. Manual shall consist of neatly edited and typed manuals of instructions (in hard cover), indexed, loose-leaf notebook) to explain use, function and control of equipment, materials and systems. Printed information shall be in 8-1/2" x 11" portrait format and cover all instructions and explanations. The Instructions shall contain the maintenance information including cleaning instructions, maintenance materials to be used, parts listed with numbers and recommended parts for Owner's stock, nearest depot for parts, wiring and piping diagrams, lubrication data and schedules, other maintenance, adjustment and repair data and a listing of names, addresses and telephone numbers of appropriate service organizations for various items and equipment.

C. The manuals shall include information on such systems and equipment as, but not limited to: heating and ventilating equipment, fan units, air conditioning, controls for mechanical systems, alarm systems, electrical distribution systems, operating equipment of general construction, mechanical and electrical work, and similar systems and equipment.

D. The Contractor shall prepare and submit Operating and Maintenance Manuals and instruct the Owner's personnel in the use and maintenance of all operating equipment. The Owner's representative and maintenance personnel shall be permitted to observe and familiarize themselves with the equipment during its assembly and installation. After installation is complete, the Contractor shall arrange to meet with the Owner's designated personnel and instruct them in the use, operation, care and cleaning of the equipment. Instructions shall only be given by qualified personnel, thoroughly familiar with the use and maintenance of the equipment.

E. Provide special tools normally furnished with equipment which are required for maintenance purposes, such as wrenches for door closures.

1.15 RECORD SET OF "AS-BUILT" DRAWINGS

A. Contractor shall provide one physical set of record drawings and a digital copy in PDF format of each sheet of the project record documents to the Architect at the completion of the Contract.

B. During construction, Contractor shall maintain a clean set of drawings for the sole purpose of recording changes and actual "as installed" information.

C. Marking of the record set shall be done mechanically as work progresses, clearly and neatly in color.

D. As a general guide, the type of information to be recorded on the record set includes: (1) revisions made, except minor or non-critical dimensions; (2) omissions, including work omitted by accepted alternates; (3) Dimensioned locations of major or main utility lines, such as conduit runs, piping mains and similar work; (4) locations of control valves; (5) additions to the work; (6) changes in significant details i.e.: for water protection); (7) changes footing or other elevations; (8) changes in locations of panel boards, outlets, drains, piping, openings, dampers, and other similar features; (9) other similar data.

End of Section

SECTION 01 42 00 - ABBREVIATIONS AND ACRONYMS

1.01 A copy of the standard Abbreviation and Notation Symbols/Legend is bound herein.

End of Section

SECTION 01 45 33 - STRUCTURAL TESTS AND SPECIAL INSPECTIONS

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 INTENT AND CONDITIONS

- A. Intent:
1. For compliance with the Minnesota State Building Code, the Owner shall employ and pay for a special inspector (or inspectors) as required by Chapter 17 of the International Building Code.
 2. Duties and responsibilities of the special inspector(s) shall be as outlined in Chapter 17 of the International Building Code and as herein specified.
 3. Define and coordinate structural tests and special inspection services.
 4. Define and coordinate conventional testing and inspection services.
 5. Testing and Inspection services are intended to assist in determining probable compliance of the work with requirements specified. These services do not relieve the Contractor of responsibility for compliance with the requirements of the Contract Documents.
- B. Conditions:
1. If inspection of fabricator's work is required, the Owner's representative may require testing and inspection of the work at the plant before shipment. Owner, Architect and Structural Engineer of Record (SER) reserve the right to reject material not complying with Contract Documents.
 2. Perform testing and inspection in accordance with industry standard used as reference for specific material or procedure unless other criteria are specified. In the absence of a referenced standard, accomplish tests in accordance with generally accepted industry standards.
 3. Failure to detect defective work or materials shall in no way prevent later rejection if defective work or materials are discovered.

1.3 RELATED REQUIREMENTS

- A. Refer to individual technical specification sections for additional qualifications, inspections, tests, frequency and standards required.

1.4 DEFINITIONS

- A. Testing: Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.
- B. Inspection: Evaluation of systems, primarily requiring observation and judgment.
- C. Structural Tests and Special Inspections: Structural Tests and Special Inspection Services herein include items required by Chapter 17 of the International Building Code as adopted by the Minnesota State Building Code, and other items which in the professional judgement of the Structural Engineer of Record, are critical to the integrity of the building structure.

- D. Conventional Testing and Inspections: Conventional Testing and Inspection Services herein describe those items not specially required by Code but may be considered essential to the proper performance of the building systems.
- E. Architect of Record: The prime consultant in charge of overall design and coordination of the Project.
- F. Structural Engineer of Record (SER): The Licensed Engineer in responsible charge of the structural design for the Project.
- G. Licensed Structural Engineer: A professional engineer with education and experience in the design of structures similar to this Project and licensed in State in which Project is located.
- H. Testing Agency (TA):
 - a. Testing Agency: Approved independent testing agency acceptable to the Owner, Architect, SER and as noted below:
 - b. Authorized to operate in the State in which the project is located and experienced with the requirements and testing methods specified in the Contract Documents.
 - c. Meeting applicable requirements of references stated in paragraph 1.4.
 - d. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards, or to accepted values of natural physical constants.
- I. Special Inspector (SI): A properly qualified individual or firm performing special inspections.
- J. The categories of special inspector are:
 - 1. Special Inspector - Technical I, II and III: Usually an employee of a testing agency:
 - a. Technical I (Sections 31 20 00) - Technician shall be under the direct supervision of a licensed civil/geotechnical engineer regularly engaged in this type of work. Work shall be performed in a qualified geotechnical/testing laboratory.
 - b. Technical I (Sections 03 30 00)
 - 1) ACI Certified Concrete Field Testing Technician – Grade I.
 - 2) ACI Certified Concrete Strength Testing Technician.
 - 3) ACI Certified Concrete Laboratory Testing Technician – Grade 1.
 - 4) ACI Certified Concrete Construction Inspector-In-Training.
 - 5) Inspector shall be employed by a testing laboratory, experienced in the type of work being performed, and under the direct supervision of a licensed civil/structural engineer.
 - c. Technical I (Section 04 20 00) - Technician shall be under the direct supervision of a licensed civil/structural engineer regularly engaged in testing and inspection of this type of work. The licensed engineer shall review and approve all inspection reports.
 - d. Technical II (Sections 31 20 00) - Technician with a minimum of 2 years' experience, or a graduate engineer, and is an employee of a qualified and approved geotechnical/technical laboratory, under the direct supervision of a licensed civil/geotechnical engineer regularly engaged in this type of work.
 - e. Technical II (Sections 03 30 00)
 - 1) ACI Certified Concrete Laboratory Testing Technician - Grade II.
 - 2) ACI Certified Laboratory Aggregate Testing Technician.
 - 3) ACI Certified Concrete Construction Inspector.
 - 4) Inspector shall be employed by a testing laboratory, experienced in the type of work being performed, and under the direct supervision of a licensed civil/structural engineer.
 - f. Technical II (Section 04 20 00) - Graduate civil/structural engineer, with experience in this type of work. Supervised by a licensed civil/structural engineer. The licensed engineer shall review and approve all inspection reports.

2. Special Inspector - Structural I and II: Usually an employee of the Structural Engineer of Record.
 - a. Structural I (Sections 03 30 00, 04 20 00, 06 10 00) - Graduate civil/structural engineer, or other personnel acceptable to the SER, with experience in the design of structural systems of this type. Inspections shall be performed under the direct supervision of a licensed civil/structural engineer.
- K. Building Official: The Officer or duly authorized representative charged with the administration and enforcement of the State Building Code.

1.5 REFERENCES

- A. See technical specification sections for specific references.
 1. ANSI/ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 2. ASTM E543 – Standard Practice for Agencies Performing Non-destructive Testing.
 3. ASTM E548 – Standard Guide for General Criteria Used for Evaluating Laboratory Competence.
 4. ASTM C1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 5. ASTM C1093 – Standard Practice for the Accreditation of Testing Agencies for Unit Masonry.
 6. ANSI/ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. Minnesota State Building Code.
- C. International Building Code.

1.6 RESPONSIBILITIES/AUTHORITY

- A. Structural Tests and Special Inspections:
 1. Special Inspector:
 - a. Attend all pre-installation meetings to review scope of structural tests and special inspections.
 - b. Test and/or inspect the work assigned for conformance with the building department approved plans, specifications, and applicable material and workmanship provisions of the code. Perform testing and inspection in a timely manner to avoid delay of work.
 - c. Bring nonconforming items to the immediate attention of the Contractor for correction, then, if uncorrected after a reasonable period of time, to the attention of the Structural Engineer of Record, the Building Official, and to the Architect.
 - d. Submit test and/or inspection reports to the Building Official, Contractor, the Structural Engineer of Record, and other designated persons in accordance with the Structural Testing and Special Inspection Schedule.
 - e. Submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the code.
 - f. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
 2. Architect:
 - a. Coordinate the flow of reports and related information to expedite resolution of construction issues.
 - b. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.

- c. Complete and sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction. Provide a completed copy of the schedule to all signed parties including Building Official.
3. Structural Engineer of Record:
 - a. Identify items requiring structural testing and special inspection including special cases.
 - b. Define "type" of special inspector required for "description" of work indicated on the Structural Testing and Special Inspection Schedule.
 - c. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.
 - d. Complete and sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
 - e. Review reports issued by all special inspectors.
 - f. If engaged as a special inspector, provide structural testing and special inspection services as noted in Article 1.6.A.1.
4. Testing Agency:
 - a. When engaged as a special inspector, provide structural testing and special inspection services as noted in Item 1.6.A.1.
 - b. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
 - c. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.
5. Contractor:
 - a. Arrange and attend all pre-installation meetings to review scope of structural testing and special inspection. Include the Building Official, Owner, Architect, SER, Testing Agency and other parties concerned.
 - b. Post or make available the Structural Testing and Special Inspection Schedule within project site office. Provide timely notification to those parties designated on the schedule so they may properly prepare for and schedule their work.
 - c. Provide special inspector access to the approved plans and specifications at the project site.
 - d. Review all reports issued by special inspectors.
 - e. Retain at the project site all reports submitted by the special inspectors for review by the building official upon request.
 - f. Correct in a timely manner, deficiencies identified in inspection and/or testing reports.
 - g. Provide safe access to the work requiring inspection and/or testing.
 - h. Provide labor and facilities to provide access to the work and to obtain, handle and deliver samples, to facilitate testing and inspection and for storage and curing of test samples.
 - i. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
 - j. Verification of conformance of work within specified tolerances is solely the responsibility of the Contractor.
6. Fabricator:
 - a. Submit a Certificate of Compliance to the Building Official, Special Inspector, and Structural Engineer of Record stating the work was performed in accordance with the Contract Documents.
 - b. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
7. Building Official:
 - a. Review all special inspector qualifications.
 - b. Review all fabricators who perform work in their shop, which requires special inspection.
 - c. Accept and sign completed Structural Testing and Special Inspection Schedule.

- d. Review reports and recommendations submitted by special inspector.
 - e. Review the "final signed reports" submitted by special inspector. These documents must be accepted and approved by the building department prior to issuance of a Certificate of Occupancy.
 - f. Determine work, which, in the Building Officials opinion, involves unusual hazards or conditions.
8. Owner:
- a. Provide and pay cost of structural testing and special inspection services.
 - b. Provide special inspector with Contract Documents and accepted shop drawings.
 - c. Provide special inspectors and testing agencies with full access to the site at all times.
 - d. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
- B. Inspections by Building Official: provide timely notice for inspections performed by the building official, as required by IBC Chapter 17, the State Building Code, and local ordinance.

1.7 INSPECTION NOTICES

- A. Contractor: Provide minimum of 24 hours notice for all items requiring testing or inspection. Do not place items requiring testing and inspection services prior to or during placement until testing and inspection services are available. Do not enclose or obscure items requiring testing and inspection services after placement until testing and inspection services are performed.

1.8 REPORTS

- A. Testing agency and/or special inspectors shall submit a report in accordance with the Structural Testing and Special Inspection Schedule and shall conduct and interpret tests and inspections and state in each report whether; (1) test specimens and observations comply with Contract Documents, and specifically state any deviations, (2) record types and locations of defects found in work, (3) record work required and performed, to correct deficiencies.
- B. Submit reports for structural testing and special inspection, in timely manner to the Contractor, Building Official, SER, and Architect.
- 1. Submit reports for ongoing work, to provide the information noted below:
 - a. Date issued.
 - b. Project title and number.
 - c. Firm name and address.
 - d. Name and signature of tester or inspector.
 - e. Date and time of sampling.
 - f. Date of test or inspection.
 - g. Identification of product and specification section.
 - h. Location in project, including elevations, grid location and detail.
 - i. Type of test or inspections.
 - j. Results of tests or inspections and interpretation of same.
 - k. Observations regarding compliance with Contract Documents or deviations there from.
 - 2. Submit final signed report stating that, to the best of the special inspector's knowledge, the work requiring testing and/or inspection conformed to the Contract Documents.

1.9 FREQUENCY OF TESTING AND INSPECTION

- A. For detailed requirements see individual technical specification sections, and Part 3 of this section.

1.10 PROTECTION AND REPAIR

- A. Upon completion of testing, sample-taking, or inspection, repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed surfaces, as judged solely by the Architect/Engineer of Record. Protect work exposed by or for testing and/or inspection and protect repaired work. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing and/or inspection.

1.11 TESTS TO DEMONSTRATE QUALIFICATION

- A. If the Contractor proposes a product material, method, or other system that has not been pre-qualified, the Architect or SER may require applicable tests, to establish a basis for acceptance or rejection. These tests will be paid for by the Contractor.
- B. The Architect or SER reserves the right to require certification or other proof that the system proposed, is in compliance with any tests, criteria or standards called for. The certificate shall be signed by a representative of an independent testing agency.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCOPE OF STRUCTURAL TESTS AND SPECIAL INSPECTIONS

- A. Refer to individual specification section articles for Quality Control testing and inspection items.

3.2 STRUCTURAL TESTS AND SPECIAL INSPECTIONS PROGRAM SUMMARY

- A. The parties involved shall complete and sign the Structural Testing and Special Inspection Schedule. The completed schedule is an element of the Contract Documents and after permit issuance, becomes part of the building department approved plans and specifications. The completed schedule shall include the following:
 - 1. Specific listing of items requiring inspection and testing.
 - 2. Associated specification section which defines applicable standards by which to judge conformance with approved plans and specifications in accordance with IBC Chapter 17 as adopted by the State Building Code. The specification section should also include the degree or basis of inspection and testing; i.e., intermittent/will-call or full-time/continuous.
 - 3. Frequency of reporting, i.e., intermittent, weekly, monthly, per floor, etc.
 - 4. Parties responsible for performing inspection and testing work.
 - 5. Required acknowledgments by each designated party.
- B. See attached "Structural Testing and Special Inspection Schedule".

END OF SECTION 01 45 33

STRUCTURAL TESTS AND SPECIAL INSPECTIONS SCHEDULE

Project Name:

Location:

Permit No.: _____(1)

STRUCTURAL TESTS AND SPECIAL INSPECTIONS				
Specification Reference (2)	Description (3)	Type of Inspector (4)	Report Frequency (5)	Assigned Firm (6)
03 30 00	Concrete Reinforcement Footings, Foundation Walls, and Piers	Tech II	Periodic	
03 30 00	Cast-In-Place Concrete Material Sampling & Testing	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Concrete Mix Verification	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Concrete Placement	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Protection & Curing	Tech II	Daily	
03 30 00	Cast-In-Place Concrete Embedded Items	Tech II	Periodic	
03 30 00	Cast-In-Place Concrete Post-Installed Anchors	Tech II	Continuous	
04 20 00	Unit Masonry Preparation & Placement	Tech II	Periodic	
04 20 00	Unit Masonry Reinforcement	Struc I	Periodic	
04 20 00	Unit Masonry Grouting	Tech II	Daily	
06 17 53	Metal Plate Connected Wood Trusses	Struc I	Periodic	
31 20 00	Earthwork	Tech II	Daily	

Notes: This schedule to be filled out and included in the project specification. Information unavailable at that time shall be filled out when applying for a building permit.

- (1) Permit No. to be provided by the Building Official.
- (2) Reference to specific technical scope section in program.
- (3) Use descriptions per IBC Chapter 17, as adopted by State Building Code.
- (4) Special Inspector – Technical, Special Inspector – Structural.
- (5) Weekly, monthly, per test/inspection, per floor, etc.
- (6) Firm contracted to perform services.

ACKNOWLEDGEMENTS

Each appropriate representative shall sign below:

Owner:	Firm:	Date:
Contractor:	Firm:	Date:
Architect:	Firm:	Date:
SER:	Firm: Meyer, Borgman, Johnson	Date:
SI-S:	Firm:	Date:
TA:	Firm:	Date:
SI-T:	Firm:	Date:
TA:	Firm:	Date:
SI-T:	Firm:	Date:
F:	Firm:	Date:
F:	Firm:	Date:

* The individual names of all prospective special inspectors and the work they intend to observe shall be identified. (Use reverse side of form, if more room is needed.).

LEGEND:

- SER = Structural Engineer of Record
- SI-S = Special Inspector – Structural
- TA = Testing Agency
- SI-T = Special Inspector – Technical
- F = Fabricator.

Accepted for the Building Department By _____
 Date. _____

SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 RELATED SECTIONS

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 CONSTRUCTION HEAT

Construction Heat. The Contractor shall maintain a minimum temperature of 65 degrees F. for plastering, taping, painting, and similar finishing.

The Contractor will provide temporary heat (if needed) during the shutdown of the mechanical system for modifications and remove the temporary heating system when no longer required.

Construction Ventilation. The Contractor will ventilate the building to the exterior as necessary to eliminate excessive humidity and condensation within the building after consultation with the Owner's on-site Facilities Manager. Power ventilation using temporary equipment shall be used as necessary.

Use of Permanent Heating and Ventilating Systems. The permanent air handling equipment may be used to provide the construction heat and ventilating. If the permanent air handling system is used, all filters shall be replaced and unit cleaned of any dust / debris before final acceptance.

Warranties. Use of the permanent heating and ventilating equipment prior to Substantial Completion shall not change the terms of any warranty required by the General Conditions and any special warranties specified elsewhere in the Contract Documents and the correction period of the General Conditions.

Permanent Heat and Ventilation. The Contractor will assume responsibility and pay the costs for heating and ventilation of Project until final acceptance by the Owner.

1.03 CONSTRUCTION LIGHT AND POWER

Temporary Light and Power. As soon as possible after commencement of the construction work, the electrical subcontractor shall determine if a temporary service terminal as required using the existing building's electrical service. Service shall be sized as determined by the General Contractor. Any costs for permits, connect / disconnect charges and meter deposits shall be paid by the General Contractor. Coordinate the location of this service with the General Contractor. The system shall provide adequate light and power to all parts of the work and be adequate for all sub-contractors involved with the project.

Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watts/sq. ft. Provide and maintain 0.25 watt/sq. ft. lighting to exterior storage and staging areas after dark for security purposes. Provide and maintain 1 watt/sq. ft. H.I.D. lighting to interior work areas after dark for security purposes.

If a contractor requires higher voltage than 120 volts, the Electrical Subcontractor shall provide the necessary temporary wiring and the contractor requiring such work shall pay the cost thereof.

If a contractor requires 3-phase power, power for tools larger than the maximum loads specified above or power for electric heating, electric welders or hoisting, that contractor shall make arrangements for a separate temporary service and distribution system and pay the energy and other costs thereof.

The Electrical Contractor shall remove the temporary system when no longer required.

Each contractor shall make arrangements and pay the costs for electrical service, lighting and power for their field office, storage sheds and other temporary buildings located outside of the existing buildings.

Use of Permanent Electrical System. The system may be used to provide construction power and testing and operation of permanent equipment. Permanent building lighting may be utilized during construction. Cost of Energy for power and lighting paid by the Owner.

1.04 CONSTRUCTION WATER

Construction Water. The temporary water service shall be coordinated with the Owner's Representative. Exercise measures to conserve water. Each contractor shall furnish his own hoses.

Remove the temporary system when no longer required.

Permanent Water. The Owner will pay the cost of water used on the site throughout the duration of the Contract.

1.05 CONSTRUCTION TOILET FACILITIES

The Contractor shall provide portable toilets for the use of all construction workers employed on the site. Location and number of facilities shall be approved in writing by the Owner's Representative. Such facilities shall be maintained by the Contractor in a sanitary condition at all times and include a final cleaning at the completion of the project.

1.06 FIRE PROTECTION

Contractor to provide fire protection on site.

1.07 TEMPORARY UTILITIES

- a. The contractor is required to provide utility services to the project site AS LISTED ABOVE for use during all construction activity. This includes:
 - i. Electrical Power
 - ii. Heat (natural gas or propane)
 - iii. Establishing accounts for each utility, to transfer into the Owners name upon project completion. (New Construction)

- b. The contractor is responsible for all temporary utilities until all signed lien waivers are turned in, all punch lists have been completed and verified by CMD Project Management staff and a Certificate of Occupancy have been obtained.

- c. The Contractor will provide documentation, included with the bid, from insurance provider that Builder's Risk Insurance can be obtained if contract is awarded. Bidder will include cost for this additional insurance coverage on bid form (line 47).

1.08 MOISTURE AND WEATHER PROTECTION

The General Contractor shall protect temporary work, the adjacent, on-site existing building and Work of the Project from damage from water, including rainwater, backing up of sewers and drains.

Provide protection against wind, storm, frost, rain, snow, heat and cold to avoid injury to material in transit, stored material and completed Work.

Provide protection against wind, storm, frost, rain, snow, heat and cold to avoid damage to the existing building throughout construction and specifically after selective demolition. Should damage to the existing building occur, the Contractor shall be responsible to clean, repair or replace as required the affected areas to the satisfaction of the Owner and Architect.

1.09 TEMPORARY WORK

The General Contractor shall provide temporary centering, scaffolding, platforms, stairs, guards, runways, lifts, ladders, temporary bracing and shoring, barricades, partitions, enclosures and such other temporary work as may be necessary for the execution of the Work and the protection of person and property. Remove temporary work when no longer required..

1.10 NOT USED

1.11 STREET CLEANING

The General Contractor shall keep public streets and sidewalks surrounding the site free from dirt, waste materials and rubbish caused by construction operations. Cleaning shall interfere with traffic as little as possible.

1.12 TEMPORARY SIGNS

The General Contractor shall provide and maintain temporary warning signs and other temporary signs required for the safe and proper execution of the Work.

No signs, billboards, or other advertisements shall be erected on the premises by the Contractor or Subcontractors, without permission of the Owner's Representative.

1.13 CONSTRUCTION HOISTING

Each contractor shall provide hoisting facilities during construction as may be necessary to accomplish their work.

1.14 CLEANUP AND RUBBISH

See Section 01505 - Construction Waste Management.

The General Contractor and/or subcontractors shall provide their own waste dumpsters. Locate waste dumpsters within the construction staging area in a location approved by the Site Superintendent and Owner's Representative.

Each contractor shall promptly remove from the premises all waste materials and rubbish resulting from the performance of the Work included in his Contract. The Contractor shall restore his own working areas of the Project to a neat and orderly condition at the end of each day's work during all period while either his employees or his subcontractors are present on the site. Cleaning up shall be a continuous operation on a day-to-day basis throughout the construction period and shall not be left to be performed after the Work or a portion of the Work is complete.

The General Contractor will coordinate the ongoing maintenance of the premises and the site and the performance of cleaning work on a regular basis. If the premises and the site are not maintained properly at all times, the General Contractor may have any accumulated waste materials or trash removed and charge that cost to the Contractor who is responsible.

Debris of a flammable nature shall not be allowed to accumulate on the floor, and when, in the opinion of the General Contractor, a potentially hazardous condition exists, the Contractor shall be directed to perform a continuous cleanup.

1.15 BUILDING & SITE SECURITY

The General Contractor shall install such barricades as required to secure the building after hours in those areas where demolition has exposed the interior of the building. Coordinate with Owner's Representative.

SITE SECURITY AND LIABILITY

- a. Until Certificate of Occupancy has been obtained and the project has been completely turned over to the Mille Lacs Band, the building is considered to be under full and complete control of the General Contractor.
- b. "Completely turned over" is defined as: all punch lists done and verified by CMD Project Management staff, keys turned over to CMD Project Management staff and entire scope of work has been delivered by the Contractor.
- c. Builder's risk insurance will be provided on all projects unless otherwise instructed by CMD Project Mgmt staff.

All issues of theft, vandalism, fire, weather or etc. will be covered and insured by the General Contractor's insurance policy and coverage.

1.16 PROTECTION OF THE PUBLIC

The Contractor shall furnish, erect and maintain all necessary barricades, suitable and sufficient warning and danger signals, lights and signs and take all necessary precautions for the safety of the Public and the protection of the work.

End of Section

SECTION 01 70 00 – CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 RELATED SECTIONS

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Closeout procedures.
- B. Prerequisites to substantial completion.
- C. Prerequisites to final acceptance.
- D. Final cleaning.
- E. Adjusting.
- F. Record Documents.
- G. Operation and maintenance data.
- H. Warranties and Bonds.
- I. Spare parts and maintenance materials.
- J. Final payment.

1.03 CLOSEOUT PROCEDURES

Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that the Work is complete in accordance with Contract Documents and ready for Architect's/Engineer's inspection.

Provide submittals to Architect/Engineer that are required by governing or other authorities.

Submit final Application for Payment and Invoice identifying total adjusted Contract Sum, previous payments, and sum remaining due.

Owner will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.04 SUBSTANTIAL COMPLETION

- A. General: Prior to requesting Architect's/Engineer's inspection for certification of substantial completion (for either entire work or portions thereof), complete the following and list known exceptions in request.
 - 1. Verify that work is sufficiently complete and that the Owner can occupy and utilize the Work for its intended use.
 - 2. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents. Provide One hard copy (paper) and 1 digital copy (pdf) of all submitted documents.
 - 3. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including (where required) occupancy permits, operating certificates, and similar physical items to Owner.
 - 4. Deliver tools, spare parts, extra stock of materials, and similar physical items to Owner.

5. Make final change-over of locks and transmit keys to Owner, and advise Owner's personnel of change-over in security provisions.
6. Complete start up testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue (or change over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-up and similar elements.
7. Complete final cleaning up requirements, including touch-up painting of marred surfaces.
8. Contractor is required to hold their insurance in place until final acceptance.

B. Inspection procedures: Upon receipt of Contractor's request, Architect/Engineer and Owner's Representative will either proceed with inspection or advise Contractor of prerequisites not fulfilled. Following initial inspection, Architect/Engineer will either prepare certificate of Substantial Completion or advise Contractor of work which must be performed prior to issuance of certificate; and repeat inspection when requested and assured that work has been substantially completed. Results of completed inspection will form initial "punch-list" for final acceptance.

1.04 CLOSEOUT SUBMITTALS

Closeout submittals include but are not necessarily limited to:

1. Two (2) copies each of operation and maintenance data for items so listed in pertinent other Sections of these Specifications, and for other items when so directed by the Architect.
2. Two (2) copies each of shop drawings and approved submittals.
3. Written Warranties.
4. Evidence of payment and release of liens. Provide final lien waivers TERO receipt with final application for payment.
5. List of Subcontractors, service organizations, and principal vendors; including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.
6. Executed Current Change Orders
7. Proof of executed Punch List, dated and signed.
8. Evidence of Completed Operations Liability insurance coverage during the 1 year warranty and correction period.
9. Waste Manifests, Toxicity Characteristics Leachate Procedure and OSHA monitoring results for asbestos or lead , as required by the contract documents.
10. Progress Construction Photographs
11. Project Record Documents.
12. Consent of Surety – AIA G707.
13. Final Contract Estimate with invoice.
14. Certificate of Substantial Completion.
15. Test Reports.
16. Energy Rebate Applications.
17. Executed Certificate of Occupancy
18. Other items that may be listed in the Specifications.

1.05 FINAL ACCEPTANCE

A. General: Prior to requesting Architect's/Engineer's final inspection for certificate of final acceptance and final payment, as required by General Conditions, complete the following and list known exceptions (if any) in request.

1. Refer to Section 01 33 00 for list of submittals.
2. Submit final releases and supporting documentation not previously submitted and accepted with Application for Payment. Include certificates of insurance for products and completed operations where required.

3. Submit certified copy of Architect's/Engineer's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect/Engineer and Owner's Representative.
4. Submit final meter readings for utilities, measured record of stored fuel, and similar data as of the time of substantial completion or when Owner took possession of and responsibility for corresponding elements of the Work.
5. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
6. The contractor shall instruct personnel in the use of the Operations and Maintenance Manual.

B. Inspection procedures: Upon receipt of above items, Architect/Engineer and Owner's Representative will reinspect the Work. Upon completion of reinspection, Architect/Engineer will prepare certificate of Final Acceptance or advise the Contractor of work not completed or obligations not fulfilled as required for final acceptance.

1.06 RECORD DOCUMENTS SUBMITTALS

A. General:

1. Refer to individual Sections of these Specifications for specific requirements.
2. Refer to Section 01300 for submittal requirements.
3. Do not use record documents for construction purposes; protect from deterioration and loss in secure, fire-resistant location.
4. Provide access to record documents for Architect's/Engineer's reference during normal working hours. Refer to Section 01500 - Temporary Facilities and Controls.
5. Give particular attention to products, substitutions, selection of options, and similar information on work where it is to be concealed or cannot otherwise be readily discerned or which would be difficult to measure and record at later date by direct observation.
6. Note related changes-orders numbers where applicable.

B. Record Drawings:

1. Maintain two sets of white-print (blue-line or black-line) of contract drawings and shop drawings in clean undamaged condition, with mark-up of actual installations which vary substantially from what work as originally shown.
2. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross reference at corresponding location of working drawings.
3. Mark in red erasable pencil where feasible; use other colors to distinguish between variations in separate categories of work.
4. Include: Revisions made, except minor or non-critical dimensions; omissions from original documents, including work omitted by alternate; exact locations of underground work; additions to the work, changes or actual elevation; changes in details; location of items shown schematically on drawings such as underground utilities; locations of items not shown on the drawings.
5. Organize record drawing sheets into manageable sets, bind with a durable paper cover sheet, and print suitable titles, dates and other identification on cover of each set.

C. Record Specifications

1. Maintain two copies of specifications including Addenda, Change Orders, and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of specifications and modifications issued.
2. Note related record drawing information and product data where applicable.

D. Record Product Data

1. Maintain two copies of each product data submittal, and mark-up significant variations in actual work in comparison with submitted information.
2. Include both variations in product delivered to site, and variations from manufacturer's instructions and recommendation for installation.

E. Record Sample Submittal:

1. Immediately prior to date(s) of substantial completion, Architect/Engineer (and including Owner's personnel where desired) will meet with Contractor on site and will determine which (if any) of submitted samples maintained buy the Contractor during progress of work are to be transmitted to Owner for record purposes.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit hard copy data bound in 8-1/2" x 11" text pages, three D-ring binders with durable plastic covers.
- B. Prepare binder covers with printed title "OPERATIONS AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below, with tab titling clearly printed under reinforced plastic tabs.
- D. Contents: Prepare a table of contents for each volume, with each product or system description identified, type on 24 pound white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors and major equipment suppliers.
 2. Part 2 : Operation and Maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. AIR and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
- E. Submit one copy of completed volumes in final form 14 days prior to final inspection. This copy will be returned after final inspection, with Architect/Engineer comments. Revise content of document as required prior to final submittal.
- F. Provide two physical copies and one digital copy, in PDF format, at final submittal.

1.08 WARRANTIES AND BONDS

- A. Execute and assemble documents from subcontractor, suppliers and manufactories.
- B. Provide Table of Contents and assemble in three, D side, ring binder with durable plastic cover.
- C. Submit prior to final application for Payment.
- D. For items of work delayed beyond date of substantial completion, provide updated submittal with ten days after acceptance, listing date of acceptance as start of warranty period.

1.09 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual specification sections.
- B. Deliver to project site and place in location directed by Owner; obtain receipt prior to final payment.

1.10 FINAL PAYMENT

- A. In requesting final inspection and accompanying the Contractor's Application and Invoice for Final Payment, the Contractor shall prepare and submit the following:
 - 1. Contractor's Affidavit of Release of Liens, AIA Document G706A, current edition.
 - 2. Contractor's Summary of Payment.
 - 3. Consent of Surety to Final Payment on AIA Document G707, current edition.
 - 4. Current list of Subcontractors and major material suppliers indicating type of work or product, brand name and/or manufacturer's name and model number in the sequential order of the Project Manual, including firm name, telephone addresses and contact person.
 - 5. All written warranties required by the Contract Documents.
- B. Submit the above documents digitally, in PDF format.

1.11 CLEANING UP

Immediately prior to the inspection for Substantial Completion, the Contractor shall remove his waste materials and rubbish from the building and site, remove protective coatings, barriers and other protective devices, temporary work and surplus materials.

The Contractor shall retain a separate cleaning company that specializes in new construction final cleaning to thoroughly clean the new building and affected existing building areas and site as necessary to leave them in a clean, neat and orderly condition, ready for occupancy and use. Wash and polish glass on both faces. Dust, vacuum, wash, and otherwise clean finish spaces as necessary to remove stains, dust, and dirt. Leave boiler rooms, mechanical rooms and similar unfinished spaces clean. Clean all surfaces directly or indirectly related to the work including the interior of all casework and cabinets.

The Mechanical Subcontractor shall wash, clean, and sterilize plumbing fixtures. Dust, vacuum, wash, and otherwise clean unit ventilators, convectors, radiation, grilles and registers, and other mechanical work in finished spaces as necessary to remove stains, dust, and dirt. Leave boilers, mechanical rooms, and similar unfinished spaces "broom clean". Remove construction dirt and debris from the interior of ductwork and air handling equipment. Replace filters for air handling equipment according to the manufacturer's instructions.

The Electrical Subcontractor shall dust, vacuum, wash and otherwise clean light fixtures and other electrical work in finished spaces to remove stains, dust, and dirt. Leave electrical equipment in boiler rooms, mechanical rooms, transformer vaults, switchgear rooms and similar unfinished spaces clean. Replace burned out lamps.

The Contractor clean sidewalks, paved areas, grass, and other planting areas adjacent to the Construction Staging Area.

Maintain the Work in a clean condition until the Architect determines that the Work is substantially complete. After Substantial Completion, the Contractor shall remove waste materials and rubbish and clean up dirt caused by his operations.

Upon completion of the Work, the Contractor shall remove his tools, construction equipment, machinery, and surplus materials from and about the Project.

END OF SECTION

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED SECTIONS

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

Related Sections: Section 01 74 19 – Construction Waste Management.
 Section 02 41 00 – Selective Demolition and Removal

1.02 SUMMARY

Definition:

1. "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
2. "Cutting and patching" is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
3. "Cutting and patching" performed during the manufacture of products, or during the initial fabrication, erection, or installation processes not considered to be "cutting and patching" under this definition.
4. Drilling of holes to install fasteners or similar operations are also not considered to be "cutting and patching".

Refer to other sections of these Specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1. Requirements of this Section apply to mechanical and electrical work unless other requirements are more stringent. Refer to Division 15 and 16 sections for additional requirements.

1.03 QUALITY ASSURANCE

Requirements for Structure of Work: Do not cut and patch structural work in a manner that would result in a reduction of load-carrying capacity or of load-deflection ratio.

Operation and Safety Limitations: Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity to perform in the manner intended, including energy performance, or that would result in increased maintenance, decreased operational life, or decreased safety.

Visual Requirements:

1. Cut and patch work exposed on the building's exterior or in its occupied spaces shall not result in lessening the building's aesthetic qualities.
2. There shall not be substantial visual evidence of cut and patch work.
3. The Architect shall be the final judge of the visual acceptability of cut and patch work.
4. Remove and replace work judged by the Architect/Engineer to be cut and patched in a visually unsatisfactory manner.

If possible, retain the original installer or fabricator, or another recognized experienced and specialized firm to cut and patch exposed work.

PART 2 - PRODUCTS

2.01 MATERIALS

Except as otherwise indicated, or as directed by the Owner, use materials for cutting and patching that are identical to the existing materials.

If identical materials are not available, or cannot be used, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect as approved by the owners representative.

Use materials for cutting and patching that will result in equal-or-better performance characteristics.

PART 3 - EXECUTION

3.01 INSPECTION

Before cutting, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work. Notify Owner Representative of possible exposure to harmful dusts, vapors, flammable or explosive materials and other potential hazards.

3.02 PREPARATION

Temporary support: To prevent failure, provide temporary support of work to be cut.

Verify location of concealed structure, electrical or mechanical services before cutting and patching. X-ray or use other methods as appropriate. This shall be considered testing for the Contractor's convenience.

Protect other work during cutting and patching to prevent damage.

Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.

Avoid interference with use of adjoining areas or interruption of free passage adjoining areas.

3.03 PERFORMANCE

General: Employ skilled workers to perform cutting and patching work. Except as otherwise indicated or as approved by the Architect/Engineer, proceed with cutting and patching at the earliest feasible time and complete the work without delay.

Cutting:

1. Cut the work using methods that are least likely to damage work to be retained or adjoining work. Where possible, review proposed procedures with the original installer; comply with original installer's recommendations. Work shall minimize and limit dust, dirt, and noise. Comply with governing regulations regarding environmental hazards and general dust control.
2. Where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping.
3. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or core drill to insure a neat hole.
4. Cut holes and slots neatly to size required with minimum disturbance of adjacent work.

5. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring the existing finished surfaces.
6. Temporarily cover opening when not in use.
7. Bypass utility services such as pipe and conduit before cutting, where such utility services are shown or required to be removed, relocated, or abandoned.
8. Cut off conduit and pipe in walls or partitions to be removed.
9. After bypassing and cutting, cap, valve, or plug and seal tight the remaining portion of pipe and/or conduit to prevent entrance of moisture or other foreign matter.

Patching: Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.

1. Where feasible, inspect and test patched areas to demonstrate integrity of work.
2. Restore exposed finishes of patched areas and, where necessary, extend finish restoration into retained adjoining work in a manner that will eliminate evidence of patching and refinishing.

3.04 CLEANING

Thoroughly clean areas where work is performed or used as access to work. Remove paint, mortar, oils, putty, caulking, and items of similar nature completely. Thoroughly clean piping, conduit, and similar features before painting or other finishing is applied.

End of Section

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT

PART ONE - GENERAL

1.01 SUMMARY

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

This section includes all labor, equipment and related services necessary to provide all Hazardous and Construction Waste Management indicated on the plans or specified herein.

1.02 REQUIREMENTS

Work in this section includes:

1. Hazardous and Solid waste management goals
2. Waste management plans.
3. Recycling.
4. Sorting and Reuse.
5. Submittals
6. List of recycling centers and haulers.

1.03 RELATED REQUIREMENTS

1. Section 01 10 00 - Summary of the Work.
2. Section 01 50 00 - Construction Facilities and Temporary Controls.
3. Section 02 41 00 - Selective Demolition.

1.04 WASTE MANAGEMENT GOALS

The Owner desires that as many materials as possible from this project, whether new construction, remodeling, or demolition be salvaged, reused or recycled.

The contractor shall provide dumpsters throughout the duration of all construction activities.

GENERAL WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Methods of trash/waste disposal that are not acceptable are:
 1. Burning on the project site.
 2. Burying on the project site.
 3. Dumping or burying on other property, public or private.
 4. Other illegal dumping or burying.
 5. Incineration, either on- or off-site.
- E. Regulatory Requirements: Contractor is responsible for knowing and complying with

regulatory requirements, including but not limited to Federal, State and Local requirements, pertaining to legal disposal of all construction and demolition waste materials.

- F. CMD Project Management staff may periodically instruct Contractor to relocate dumpster as necessary to prevent parking hazards, snow removal or as deemed necessary.

1.05 HAZARDOUS AND SOLID WASTE MANAGEMENT PLAN

Within 10 days after a signed construction contract is in place, the Contractor shall develop with the Owner and Architect a Demolition and Construction Hazardous Waste and Solid Waste Management Plan. Each plan shall include the following:

1. Determine which construction materials can be salvaged for reuse or resale.
2. Determine which construction materials can be recycled.
3. Estimated quantities of recycled, reused or salvaged materials.
4. Identify separation requirements.
5. Method of on site temporary storage.
6. Demolition and Construction Hazardous Waste Log. Log shall include dates, facility, transporter, weights and a file of waste receipts and shipping papers for all waste shipped off-site.
7. Transportation method and Destinations

1.06 SUBMITTALS AND IMPLEMENTATION

Hazardous Waste :

The Contractor shall submit the Waste Management Plan to the hazardous materials manager (Owner's Representative).

The Hazardous Waste Log shall be submitted at the end of demolition and at the end of construction.

Solid Waste:

The Contractor shall submit the Solid Waste Management Plan to the owner's representative and include whether the construction waste shall be recycled or reused by source separation, time-based separation or co-mingled for delivery to an off-site separation facility.

The Contractor shall designate an on-site party that is responsible for implementing the plan and instructing workers during orientation and safety meetings. This person shall instruct workers on separation, handling and recovery methods. Each subcontractor shall have a copy of the Plan.

1.07 COMPLIANCE

Comply with all laws, rules, and regulations of governmental Authorities having jurisdiction over the work including removal of debris from the site and Pollution Control Agency Hazardous Waste Rules, Chapter 7045.

1.08 PROTECTION

Perform all work carefully to prevent fires or other hazards to persons and property, and to avoid damage to recycled, reused or salvaged materials.

Report to the Owner immediately if any toxic or harmful materials are uncovered and stop work until situation is remedied.

1.09 RECYCLING

The following materials can be recycled in the Duluth Metropolitan area:

1. Dimensional lumber, crates or pallets
2. Concrete and concrete masonry materials.
3. Asphaltic concrete pavement.
4. Corrugated cardboard.
5. Metals

PART TWO - MATERIALS

2.01 PRODUCTS

None required.

PART THREE - EXECUTION

Not used.

End of Section

SECTION 02 10 00

SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removal and disposal of vegetation and topsoil.
2. Removal and disposal of tree, stump, and roots.
3. Removal and disposal of concrete construction.
4. Removal and disposal of pavements.
5. Removal and disposal of fence construction.
6. Removal and disposal of gravel surfacing.
7. Removal and disposal of bollards.
8. Removal and disposal of utility piping.
9. Removal and disposal of miscellaneous construction.

1.02 PROTECTION OF EXISTING CONDITIONS

- A.** Provide protection necessary to prevent damage to existing conditions indicated to remain in place.
- B.** Restore all damaged areas to their original condition, as acceptable to the Owner.

1.03 SUBMITTALS REGARDING EXISTING CONDITIONS

- A.** Provide pre-demolition photographs of the existing conditions prior to beginning any work at the site.
- B.** Bring to the attention of the Engineer in writing within 48 hours any items damaged during the demolition process that are to be salvaged for re-use. If it is determined that the damage to the item(s) could have been prevented by the Contractor taking reasonable measures or precautions, the damaged item(s) will be replaced or repaired at the Contractor's expense.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SITE ACCESS

- A.** Demolition and removal operations shall be performed to ensure minimum interference with roads, parking lots, sidewalks and pathways.
- B.** Erect temporary fencing as necessary to keep people out of the work area.

3.02 DEMOLITION

- A.** Remove vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated.
- B.** Store salvaged materials on-site in a location where they will not be damaged or interfere with the use of the facilities.
- C.** Promptly dispose of demolished materials off-site. Do not allow demolition materials and debris to accumulate on-site.
- D.** Restore all damaged underground piping and utilities, including irrigation.

END OF SECTION

SECTION 02 41 00 - SELECTIVE DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This section includes all labor, equipment and related services necessary to provide all selective demolition and removal to the existing building indicated on the plans or specified herein.

1.03 RELATED SECTIONS

1. Selective Site Demolition Section 02 10 00
2. Site Clearing Section 31 10 00
3. Excavation Section 31 20 00

1.04 QUALITY ASSURANCE

A. Comply with all laws, rules, and regulations of governmental Authorities having jurisdiction over the work including removal of debris from the site.

B. Perform the demolition work in accordance with ANSI/NFPA 241, Building Construction and Demolition Operations.

1.05 PROTECTION

Perform all work carefully to prevent fires or other hazards to persons and property, and to avoid damage to materials being saved.

Provide temporary shoring and bracing where required.

Provide barricades and other safety devices for protection of all.

Repair any damage done by demolition operations when not included as part of the finished work.

Report to the Architect immediately if any toxic or harmful materials are uncovered and stop work until situation is remedied.

PART 2 - MATERIALS

2.01 PRODUCTS

(NONE REQUIRED)

PART 3 – EXECUTION

3.01 PREPARATION

Schedule and coordinate work with the Owner, Architect, and other contractors providing work on the site.

Visit the site and review demolition work in conjunction with the building plans. Determine if any discrepancies exist and notify the Architect if any. Mark areas for demolition and mark hidden items such as underground piping that are to remain.

3.02 SALVAGE OF EXISTING MATERIALS, FURNISHINGS AND EQUIPMENT

All items of value indicated to be removed or required to be removed for the new construction and not reused shall be turned over to the Owner for review. Items refused by the Owner shall be removed off the site and disposed of legally.

3.03 DEMOLITION

Contractor shall do all demolition work noted on the drawings, specified herein or otherwise required to provide the new construction.

Contractor shall perform all miscellaneous items of demolition required to install new work or finishes. Contractor shall remove existing finishes if required to provide a suitable surface for new finishes.

Areas that will be exposed as part of the finished work shall be neatly cut or sawn, with straight lines ready to become part of the finished product.

Do not let debris accumulate in or around the building but dispose of immediately. Leave each area broom clean upon completion of the work.

End of Section

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

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 specifies cast-in place concrete, including formwork, reinforcement, vapor retarder, joint dowels, concrete materials, mixture design, placement procedures, finishes and all related accessories, for the following:
1. Footings.
 2. Slabs-on-grade.
 3. Miscellaneous concrete items.
 4. Masonry core fill.
 5. Placement of embedded items provided by other trades
- B. Related Requirements:
1. Division 01 Section "Structural Tests and Special Inspections".
 2. Division 05 Sections for items cast into concrete.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Organization (AASHTO): M182 Burlap Cloth made from Jute or Kenaf.
- B. American Concrete Institute (ACI):
1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
 3. ACI 301 - Specifications for Structural Concrete for Buildings.
 4. ACI 302 – Guide for Concrete Floor and Slab Construction.
 5. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 6. ACI 305 - Hot Weather Concreting.
 7. ACI 306 - Cold Weather Concreting.
 8. ACI 308 – Standard Practice for Curing Concrete.
 9. ACI 308.1 – Standard Specification for Curing Concrete.
 10. ACI 309 - Guide for Consolidation of Concrete.
 11. ACI 318 - Building Code Requirements for Structural Concrete.
- C. American Institute of Steel Construction (AISC): Code of Standard Practice for Buildings and Bridges.
- D. American National Standards Institute (ANSI): NSF Standard 61.
- E. American Plywood Association (APA) - Product Standard PS1, Construction and Industrial Plywood.
- F. American Society for Testing and Materials (ASTM).
- G. Council of American Structural Engineers of Minnesota (CASE/MN): Guideline for Special Structural Inspection and Testing.

- H. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Manual of Standard Practice.
 - 2. Placing Reinforcing Bars.
- I. International Building Code (IBC).
- J. Minnesota State Building Code (MSBC).
- K. National Ready Mixed Concrete Association (NRMCA): Certification of Ready Mixed Concrete Production Facilities.
- L. Portland Concrete Association (PCA): Sandblasting of Concrete Surfaces IS 180T.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Form-release agents
 - 2. Concrete Admixtures.
 - 3. Curing Materials.
 - 4. Waterstops.
 - 5. Bonding Agents.
 - 6. Adhesives.
 - 7. Synthetic fibers.
- B. Shop Drawings: Submit in accordance with ACI 315, "Standards on Details and Detailing of Concrete Reinforcement".
 - 1. Provide detail placing drawings that illustrate fabrication, bending, and placement of reinforcement.
 - 2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Concrete Mix Designs: Each concrete mix design submittal shall contain the following information:
 - 1. Mix Number (which will correspond to mix ticket on trucks delivered to site).
 - 2. Application for which concrete is designed (i.e. – footings, slabs, etc...)
 - 3. Applicable mix performance criteria including:
 - a. Final Design strength at 28 days.
 - b. Unit Weight.
 - c. Air Content.
 - d. Slump (with water only and after addition of WRA and/or HRWRA).
 - 4. Applicable mix ingredients including quantities, ASTM designations, and sources for:
 - a. Cementitious materials.
 - b. Aggregate source, geological type, size, and shape.
 - 1) Include total gradation for combined coarse and fine aggregates for mixes specified to contain Well Graded Aggregate.
 - 2) Included calculated Coarseness Factor and Workability Factor for mixes specifying limits on these values.
 - c. Water.

- 1) Indicate amount of mixing water to be withheld for later addition at Project site.
- d. Water cementitious materials ratio, w/cm.
- e. Admixtures.
- f. Fibers and other additions.
- 5. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Proposed construction joint and saw-cut contraction joint locations for slabs-on-grade.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

- 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Joint Sealers and Curing Materials: Deliver in original factory packaging and unopened containers and protect from damage and contamination.

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. 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 FORM-FACING MATERIALS

A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. 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.

- 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775, epoxy coated.

2.4 JOINT DOWELS

- A. Diamond Plate Dowels: Saw cut from ASTM A 36 hot rolled plate.
1. Available Products:
 - a. Diamond Dowel™ by PNA, Inc.
- B. Smooth Plate Dowels and Baskets:
1. Approved Manufacturers:
 - a. PNA, Inc.

2.5 REINFORCEMENT ACCESSORIES

- A. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.
1. Available Products:
 - a. 3M Scotchkote 213PC or liquid, two-part, epoxy repair coating or approved equal.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, or plastic according to CRSI's "Manual of Standard Practice," and as follows:
1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- C. Supports for slabs-on-grade with steel reinforcement: Use supports with sand plates or horizontal runners.
1. Dayton Richmond: Aztec E-Z Chair – PEZ with E-Z Chair Sand Plate PSP.
 2. General Technologies, Inc.: Composite Chairs on Sand Plates.

2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice" and accepted shop drawings.
- B. Do not re-bend or straighten steel reinforcement except where specifically accepted.

2.7 CONCRETE MATERIALS

- A. Cementitious and Pozzolanic Materials: Use the following materials, of the same type, brand, and source for each required type of concrete and on which selection of concrete proportions was based:

1. Portland Cement: ASTM C 150, Type IL.
 - a. Use white Portland cement where indicated for decorative concrete such as, colored concrete, or other applications noted by Architect.
 - b. For exposed concrete, use same brand throughout.
 2. Fly Ash: ASTM C 618, Class C or F, and as specified herein.
 - a. Available Alkalis, as Na₂O equivalent: 1.5% maximum
 - b. Loss On Ignition (LOI): 1% maximum
 - c. Calcium Oxide Limit (CaO): 20% maximum
 3. Replacement Ratio: Portland cement shall be replaced on an equal mass (not weight) basis. Material replacements shall be expressed as a percent, by mass, of the total cementitious materials content, with proportions selected for 28 day compressive strengths equal to those specified. The change in volume resulting from the substitutions shall be determined and an adjustment in both coarse and fine aggregate proportions shall be determined in order to ensure a unit volume.
 - a. Fly Ash replacement shall not exceed 30% for Class C, 20% for Class F, or as specified for a particular mix design.
- B. Normal-Weight Aggregates: ASTM C 33. Do not use aggregates containing soluble salts or other substances which can cause stains on exposed surfaces. Use aggregates from one source of supply corresponding to that on which selection of concrete proportions was based.
1. Coarse Aggregate: Minimum Class Designation:
 - a. Class 3S Typical
 - b. Class 4S Exterior horizontal concrete
 - 1) Maximum absorption 1.7%
 - c. Class 5S Exterior exposed architectural concrete
 - 1) Maximum absorption 1.7%
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94 and potable.

2.8 ADMIXTURES

- A. General: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use admixtures containing calcium chloride or thiocyanates.
- B. Air-Entraining Admixture (AEA): ASTM C 260.
- C. Water-Reducing Admixture (WRA): ASTM C 494, Type A.
- D. Mid-Range Water-Reducing Admixture (MRWRA): ASTM C 494, Type A.
- E. Polycarboxylate High-Range Water-Reducing Admixture (HRWRA): ASTM C 494, Type F.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type B and D.
- G. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E.
- H. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures effectively containing chloride ions (more than 0.05 percent) are not permitted.

2.9 CURING, CLEANING, AND SEALING MATERIALS

- A. Water Cure:

1. Waterproof paper.
2. Reef Industries: Transguard Economy Grade. (ASTM C 171, 20-mils thick, polypropylene sheet with nonperforated white coating.)
3. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
4. Dayton Bag and Burlap: Burlene.
5. Reef Industries: Transguard 4000; 42-mil thick, fiber mat with polyethylene sheet backing.

B. Water: ASTM C 94 and potable.

C. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.

1. Available Products:
 - a. ChemMasters; Spray-Cure & Seal Plus.
 - b. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - c. Euclid Chemical Company; Super Diamond Clear.
 - d. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - e. Meadows, W. R., Inc.; CS-309/30.
 - f. SpecChem, LLC; Cure & Seal 25 UV

D. Clear, Non-yellowing, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.

1. Available Products:
 - a. BASF; Kure 1315
 - b. Burke by Edoco; Cureseal 1315 WB.
 - c. ChemMasters; Polyseal WB.
 - d. Euclid Chemical Company; Super Diamond Clear VOX.
 - e. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - f. Meadows, W. R., Inc.; Vocomp-30.
 - g. SpecChem, LLC; Cure & Seal WB 25

2.10 JOINT MATERIALS

A. Equipment Control joint saw:

1. Available Products:
 - a. Soff-Cut International; "Soff-Cut System," early-entry dry-cut saw with Skid Plate.

B. Expansion Joint Material: ASTM D 1751, asphalt-saturated cellulosic fiber.

1. Available Manufacturers:
 - a. W.R. Meadows.
 - b. BASF.

C. Joint Backer Rod: Flexible, compressible, closed-cell polyethylene foam, not less than 10 psi compression deflection.

D. Interior Joint Sealer: Mameco, Vulkem 45.

E. Interior Bond Breaker Joint: 30 pound asphalt felt, unperforated.

2.11 RELATED MATERIALS

A. Under Slab Vapor Retarder: ASTM E1745, Class A.

1. Manufacturers and Products:
 - a. Barrier Bac, Inc., VB250 or VB350.

- b. Raven Industries, Vapor Block 10 or 15.
- c. Reef Industries, Inc., Vaporguard.
- d. Stego Industries, Stego Wrap Vapor Barrier 15 mil.
- 2. Accessories:
 - a. Seam tape: High density polyethylene tape with pressure sensitive adhesive, minimum 4 inches wide.
 - b. Pipe boots: Constructed from vapor barrier membrane and seam tape.

2.12 CONCRETE MIXING

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, with exceptions specified herein, and ASTM C 1116 where fibers are used, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- C. Admixtures: Use approved admixtures according to manufacturer's written instructions.
 - 1. Use chemical admixtures in concrete, as required, for placement, workability, durability, and controlled set time.
- D. Air Content: Do not allow air content of hard-troweled finished floors to exceed 3 percent.
- E. Concrete Slump Limits: Measured according to ASTM C 143 at point of placement.
 - 1. 4 inches without water reducing admixtures
 - 2. 5 inches after addition of WRA or MWRA.
 - 3. 7 inches after addition of HRWRA.
 - 4. A tolerance of up to one inch above indicated maximum will be allowed for one batch in any five consecutive batches tested.
 - 5. If the maximum water-cement ratio is not exceeded, concrete arriving at the jobsite within 60 minutes of the initial batching that has a slump less than the maximum allowed may have water added when accepted by the project inspector.
 - 6. Water reducing admixtures may be added to increase the slump when water can not be added and additional slump is necessary for workability when accepted by the project inspector.
 - 7. Water shall not be added to the mix after any supplemental water reducing admixtures have been dosed into the mixer.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:

Item	Requirements
Compressive Strength at 28 days (min), f_c	3000 psi
Maximum Cementitious Content	520 lb/cy
Maximum water/cementitious materials ratio, w/cm	0.50
Cementitious Materials	
Portland Cement, Type I or Type I/II	85% maximum
Supplementary Cementitious Materials	15% minimum
Top Size Aggregate	1-1/2 inch

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

Item	Requirements
Compressive Strength at 28 days (min), f_c	4000 psi
Maximum Cementitious Content	520 lbs/yd ³
Maximum water/cementitious materials ratio, w/cm	0.44 Exterior 0.47 Interior
Cementitious Materials	
Portland Cement, Type I or Type I/II	85% maximum
Fly Ash, Class C or F	0% - 40%
GGBFS	0% - 20%
Minimum Top Size Aggregate	¾" inch
Coarseness Factor	52 - 70
Workability Factor	32 - 40
Air Content (at point of placement) for slabs exposed to freezing and thawing	5.5% (± 1.5%)

C. Miscellaneous Concrete Items: Concrete stair pan fill, curbs, housekeeping pads, etc. Proportion normal-weight concrete mixture as follows:

Item	Requirements
Compressive Strength at 28 days (min), f_c	3500 psi
Maximum water/cementitious materials ratio, w/cm	0.45
Cementitious Materials	
Portland Cement, Type I or Type I/II	85% maximum
Supplementary Cementitious Materials	15% minimum
Minimum Top Size Aggregate	1/2 inch

D. Masonry Core Fill Concrete: Proportion normal-weight concrete mixture as follows:

Item	Requirements
Compressive Strength at 28 days (min), f_c	3000 psi
Maximum water/cementitious materials ratio, w/cm	0.60
Cementitious Materials	
Portland Cement, Type I or Type I/II	80% maximum
Supplementary Cementitious Materials	20% minimum
Maximum Top Size Aggregate	1/2 inch

PART 3 - EXECUTION

3.1 GENERAL

A. Work shall conform to ACI 117 and ACI 301, except as modified by requirements of these Contract Documents.

3.2 PREPARATION

A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication; show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to

pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads. Contractor's licensed specialty structural engineer shall design formwork to satisfy applicable codes and all imposed loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Chamfer exterior corners and edges of permanently exposed concrete.
- G. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of footings, foundation walls, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.6 REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" and accepted shop drawings for placing reinforcement.
- B. Underfloor Vapor Retarders: When chairing reinforcement on top of underfloor vapor retarders, use only supports with integral sand plates.
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal cuts or punctures in vapor retarder before placing concrete.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- D. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- E. Provide bar supports in sufficient number and heavy enough to carry steel they support. Place no bar more than 2 inches beyond last leg of continuous bar support. Do not use bar supports to support runways for concrete buggies, or similar loads.
 - 1. Maximum support bar spacing shall not exceed 48 inches.
- F. Maximum bolster spacing shall not exceed 36 inches for #4 support bar or 48 inches for #5 support bar.
- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- H. Steel reinforcement partially embedded in concrete shall not be field bent, except as indicated or permitted by Structural Engineer.
- I. For walls reinforced on both faces, provide spreader bars and chairs to surfaces of forms on each side at spacings not to exceed 8 feet in either direction. For walls with single layer of reinforcing, provide chairs each side at spacings not to exceed 8 feet in either direction.
- J. Install welded wire reinforcement in longest practicable lengths. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- K. Install diamond plate dowels in concrete slab-on-grade joints where shown. Install diamond plate dowels per manufacturer's written instructions.

3.7 REINFORCEMENT PROTECTION AND REPAIR

- A. Install additional bar supports at locations where reinforcement position is not maintained due to collapsed chairs or construction activity from time of original placement.
- B. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.8 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 2. Form joints with keyways and/or dowels as detailed. Embed keys at least 1-1/2 inches into concrete.
 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows where not specifically shown on Drawings:
1. Interior Slabs:
 - a. Spacing shall not exceed 36 times slab thickness; 15 feet on center, maximum.
 - b. Short: long side ratio not less than 2:3.
 2. Interior Slabs with Carpeting:
 - a. Spacing shall not exceed 48 times slab thickness; 20 feet on center, maximum.
 - b. Short: long side ratio not less than 2:3
 3. Sawed Joints: Form contraction joints with early-entry dry-cut 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 concrete develops random contraction cracks.
 - a. Install cuts 0 to 2 hours after final finishing and prior to final set.
 - b. Install joint protector at saw-cut intersections prior to cross cut.
 4. Provide cleanly cut, straight joints in toppings over joints in base slab.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install expansion joint material at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.
1. Extend expansion joint material full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width expansion joint material not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install expansion joint material in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- D. Install diamond plate dowels in concrete slab-on-grade joints where shown. Install diamond plate dowels per manufacturer's written instructions.
- E. Sidewalks: Unless noted or detailed otherwise provide for expansion joints in sidewalks at intervals not to exceed 40 feet on centers and where walks abut curbs, stoops, walls or other fixed objects. Expansion joints shall be 1/2 inch wide using expansion joint materials. Provide tooled weak plane joints across sidewalks, one inch deep by 1/4 inch at 5 feet intervals, unless otherwise noted. Tool edges of joints to 1/8 inch radius.
- F. Curbs: Provide control joints in poured in place concrete curbs 10 feet o.c. maximum spacings with expansion joints not over 40 feet o.c. Make control joints by cutting approximately 1/8 inch wide by one inch to 1-1/2 inch deep into exposed surfaces. Expansion joints shall be 1/2 inch wide with expansion joint material. At curbs adjacent to sidewalks, align joints in curb and sidewalk.

3.9 INSTALLING UNDER SLAB VAPOR RETARDER

- A. Install according to membrane manufacturer's current published instructions and ASTM E1643.

- B. Install over level granular base and under reinforcing and slabs on grade.
- C. Lap over footings and seal to foundation walls.
- D. Overlap membrane joints minimum 6 inches and seal continuously with seam tape.
- E. Seal penetrations and pipes with pipe boot fashioned from membrane and sealed with seam tape.
- F. Repair damaged membrane with patches of membrane overlapping damage minimum 6 inches and sealing completely with seam tape.

3.10 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding water-reducing admixtures to mixture.
- C. Clean forms, reinforcing and accessories and lubricate forms prior to placing concrete.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not allow concrete to drop freely more than 4 feet.
 - 4. Use approved chutes equipped with suitable hoppers for placing where required.
 - 5. Place at rate that concrete is always plastic and flows readily into every space.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Before concrete slabs on grade are placed, verify that granular base is level and compacted.
 - 2. Sprinkle base to eliminate suction of water from concrete.
 - 3. Allow no freestanding water.
 - 4. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 5. Maintain reinforcement in position on chairs during concrete placement.
 - 6. Do not insert vibrators to bottom of slabs-on-grade with underfloor vapor retarders to avoid damaging this membrane.
 - 7. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 8. Slope surfaces uniformly to drains where required.
 - 9. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Do not use concrete that has partially hardened or been contaminated by foreign materials, nor concrete that has been retempered or remixed after initial set.

- G. Before depositing new concrete on or against concrete that has set at construction joints, clean, wet and apply bonding agent to existing surfaces. Tighten forms prior to resuming pouring.
- H. Exercise care to prevent splashing of forms or reinforcing with concrete above level of concrete being placed.
- I. Clean reinforcement projecting above or out of concrete immediately after completion of particular unit of pour.
- J. Do not place concrete under adverse weather conditions unless adequate protection is provided. Refer to ACI 301, for weather restrictions and placing temperatures.

3.11 COLD WEATHER CONCRETING

- A. 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 average high and low temperature is expected to fall below 40 deg F, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
 - 4. Ensure minimum temperatures are maintained for the duration of the curing period in accordance with ACI 306.1.
 - 5. Concrete shall be allowed to dry for at least 12 hours before removing temperature protection for water cured or moisture retention cured concrete.

3.12 HOT WEATHER CONCRETING

- A. Hot-Weather Placement: Comply with ACI 305 and as follows:
 - 1. When high temperature, measured on jobsite at concrete placement area, is expected to rise above 90 deg F, maintain concrete temperature below 90 deg F at time of placement. 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. When temperature of steel reinforcement, embeds, subgrade, or forms is greater than 120 degrees F, fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
 - 3. Protect concrete from wind and direct sunlight to avoid rapid drying.
 - 4. Apply evaporation retarder to unformed concrete surfaces if the air temperature exceeds 80 degrees F, the wind speed exceeds 10 mph, or the relative humidity is less than 40%. Apply according to manufacturer's written instructions immediately after placing and screeding.
 - 5. Apply moisture retaining covers or wet cure in accordance with concrete curing and protection methods as specified.

3.13 FINISHING FLOORS AND SLABS

- A. Finish bare concrete floors (adjacent to floors with other surfacing) so concrete surface is level with other finishes, unless otherwise noted.

- B. At areas to receive floor covering, grind joints smooth between slabs on grade and structural slabs and between existing and new surfaces to eliminate unevenness and to provide smooth, level surface across joints.
- C. Wetting the concrete surface during finishing operations is prohibited.
- D. Power floating with troweling machines equipped with normal trowel blades is prohibited.
- E. Protect finished surfaces from damage. Keep free of abrasive materials.
- F. In areas where water will be present (interior and exterior) place and finish slabs so areas will drain and water will not stand in puddles. Conform to slopes shown. Where elevations and slopes are not indicated, generally slope floors 1/8 inch per foot uniformly to drains, unless otherwise directed by Architect.
- G. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8-inch.
- H. Apply slab finish to Floor Profile Number tolerances listed unless specifically noted otherwise on Drawings, according to ASTM E 1155 "Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers" for randomly trafficked floor surfaces.
 - 1. Refer to ACI 302, Chapter 8 and Table 8.15.3, for recommended typical procedures to attain specified Floor Profile Numbers.
- I. General Finishing Requirements: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces as appropriate to attain slab finish specified.
 - 1. Utilize wet-screed guides, dry-screed guides, and/or edge forms for initial strikeoff set with optical or laser instruments as appropriate to attain specified Floor Profile Number. Check elevation after initial strikeoff and repeat as necessary.
 - 2. Smooth and restraighen surface using 8 to 10 foot wide bull float, darby, or modified highway straightedge.
 - a. Apply in two directions at 45 degree angle to strip for Overall Floor Flatness, F_F 30 or greater.
 - 3. Wait until bleed water sheen has disappeared and concrete can sustain finishing operations employed without digging in or disrupting the levelness of the surface.
 - 4. Float surface with one or more passes using a power float (float shoe blades or pans) or by hand floating if area is small or inaccessible to power driven floats. Restraighen, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
- J. CONC FIN-1: Float Finish.
 - 1. Follow General Finishing Requirements for initial procedures.
- K. CONC FIN-2: Light Trowel Finish.
 - 1. Follow General Finishing Requirements for initial procedures.
 - 2. Restraighen surface if required following paste-generating float passes using 10-foot wide highway straightedge.
 - 3. Consolidate concrete surface, uniform in texture and appearance, with one to two passes using power trowel. Hand trowel areas inaccessible by power trowel.
- L. CONC FIN-3: Medium Trowel Finish.
 - 1. Follow General Finishing Requirements for initial procedures.

- 2. Restraighten surface if required following paste-generating float passes using 10-foot wide highway straightedge. Apply in two directions at 45 degree angle to strip. Use supplementary material to fill low spots.
 - 3. Consolidate concrete surface, uniform in texture and appearance, with two to three passes using power trowel. Hand trowel areas inaccessible by power trowel.
- M. CONC FIN-4: Hard Trowel Finish.
- 1. Follow General Finishing Requirements for initial procedures.
 - 2. Restraighten surface if required following paste-generating float passes using 10-foot wide highway straightedge. Apply in two directions at 45 degree angle to strip. Use supplementary material to fill low spots.
 - 3. Consolidate concrete surface, uniform in texture and appearance, with three or more passes using power trowel. Hand trowel areas inaccessible by power trowel.
- N. CONC FIN-5: Trowel and Fine Broom Finish.
- 1. Follow General Finishing Requirements for initial procedures.
 - 2. Consolidate concrete surface, with one pass using a power trowel.
 - 3. Slightly scarify surface with soft bristled broom while concrete is still plastic.
- O. CONC FIN-8: Broom Finish.
- 1. Follow General Finishing Requirements, steps 1 through 3, for initial procedures.
 - 2. Scarify surface with a transverse scored texture using a medium bristled broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
 - 3. Finish Tolerance: Surface shall not vary by more than $\pm 1/2$ inch anywhere from elevation noted on Drawings.
 - 4. Finish all concrete slabs to proper elevations to insure that all surface moisture will drain freely, and that no puddles exist. Contractor must bear cost of any corrections to provide positive drainage and repairing poorly finished surface areas.
- P. Coordinate final slab texture requirements with Division 9 flooring installer for proper adhesion of final flooring materials.
- Q. Summary Slab Finish Schedule:

SLAB USE	SLAB FINISH
Thin set resilient flooring; paint; or other thin film-finish coating system	CONC FIN-3 Medium Trowel Finish
Exposed to view with light foot traffic	CONC FIN-4 Hard Trowel Finish
Exposed to view – exterior exposure	CONC FIN-8 Broom Finish

3.14 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to formed concrete surfaces unless indicated otherwise.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent

formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.16 CONCRETE PROTECTING AND CURING

- A. General: Concrete shall be maintained above 50-degrees F and in a moist condition for at least the first seven days after placement. Provide curing and protection immediately after placement in accordance with ACI 301 using materials as specified herein.
- B. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Wet Curing: Keep surfaces continuously wet for not less than three days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - d. Protect surface from rapid loss of moisture upon termination of wet curing by covering with moisture-retaining covers for the remainder of the curing period.
 - 2. 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.
 - 3. Curing and Sealing Compound: Apply uniformly to floors and slabs in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- E. Wet cure or use moisture-retaining covers on all concrete surfaces for first 24 hours, minimum.
 - 1. Continue curing in this manner for as long as Hot Weather Concreting conditions persist.

- F. Curing and Sealing Compounds shall not be used on concrete surfaces to receive adhered coverings without prior manufacturer certification that it will not interfere with bonding of floor covering and warranties of flooring installer are validated.
- G. Moisture Condition of Slabs – Following placement of concrete and climatization of building, check to see that any specified tests for moisture emission have been made and a written report submitted prior to floor covering or coating installation.

3.17 JOINT SEALING

- A. When concrete has cured 30 to 90 days, and space has assumed its normal operating temperature, rake out loose debris and clean joint with compressed air.
- B. Install backer rod and sealant according to manufacturer's published recommendations.
- C. Protect joint completely from traffic for 24 hours.

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval and in accordance with ACI 301. Repair methods for defects affecting the concrete's structural performance shall be closely coordinated between Contractor and Engineer.
- B. Patching Mortar: Submit proposed patching materials for Architect's review and approval.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.19 FIELD QUALITY CONTROL

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- A. Contractor will assign an individual to monitor reinforcement position during concrete placement and reposition bars that are displaced due to construction activity.
- B. The Owner will engage a qualified testing and inspection agency to provide special inspection and testing services and prepare reports in accordance with Division 01Section Structural Tests and Special Inspections", and with IBC 2006 Chapter 17 as adopted by the 2007 MSBC, and the CASE/Mn Guideline for Special Structural Inspection and Testing, and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.
- C. Contractor will cooperate with and assist testing agency in obtaining representative concrete samples as concrete is placed for determining slump and air entrainment and casting test cylinders.
 1. Provide suitable space on site for storage for field condition test cylinders.
 2. If testing agency is not available, cast compression test cylinders as concrete is placed, determine and record slump of concrete, determine and record air content of concrete and submit cylinders and information to the testing agency.
- D. General Inspections Items (Technical 1):
 1. Verification of formwork size.
 2. Verification of reinforcement.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
- E. Formwork Inspection (Technical 1) :

1. Inspect formwork prior to concrete placement to verify resulting element width, depth and length correspond to those indicated on formwork installation drawings and Contract Documents.
- F. Reinforcement Inspection (Technical 1):
1. Inspect reinforcement in all cast-in-place concrete footings, and foundation frost walls, excluding slabs on grade, and footings without transverse reinforcement.
 2. Verify reinforcing bar grade.
 3. Verify reinforcing bars are free of dirt, excessive rust and damage.
 4. Verify reinforcing bars are adequately tied, chaired and supported to prevent displacement during concrete placement.
 5. Verify proper clear distances between bars and to surfaces of concrete.
 6. Verify reinforcing bar size and placement.
 7. Verify bar laps for proper length and stagger and bar bends for minimum diameter, slope and length.
 8. Verify epoxy coating is present at locations noted on the Contract Documents, include tie wires, chairs, bolsters, etc. Verify coating damage is repaired in accordance with the Contract Documents.
 9. Verify dosage of synthetic fiber reinforcement on all truck batch ticket reports.
- G. Concrete Tests (Technical 1): Testing of composite samples of fresh concrete obtained according to ASTM C 172 - Practice for Sampling Freshly Mixed Concrete, ASTM C 31 - Practice for Making and Curing Concrete Test Specimens in the Field, and ASTM C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens. Evaluation and acceptance of concrete shall be in accordance with ACI 318 and according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture where less than 50 yd³ is placed, plus one additional set for each additional 100 yd³ or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of discharge for each composite sample.
 - a. Perform additional tests when concrete consistency appears to change.
 3. Air Content: When air content is specified, perform test in accordance with ASTM C 231, pressure method, for normal-weight concrete and ASTM C 173, volumetric method, for structural lightweight concrete.
 - a. Where placement is by pump, air content shall be measured at location of placement.
 - b. For concrete exposed to freezing and thawing, concrete from each truck shall be tested and concrete not meeting specified percentages shall not be placed.
 - c. For interior concrete not exposed to freezing and thawing perform one test for each set of test cylinders.
 - d. Concrete used in performing air content test shall not be used in fabricating test specimens
 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 composite sample.
 5. Unit Weight: ASTM C 567, equilibrium unit weight of structural lightweight concrete; one test for each composite sample.
 6. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - b. Cast and field cure one cylinder specimen for each composite sample.
 - 1) Store field-cured cylinders as near as possible to location of concrete represented by sample and give cylinder, insofar as practicable, same protection and curing as adjacent concrete.

- c. If additional specimens are required to verify early strength of concrete, contractor must pay for additional testing.
- 7. Compressive-Strength Tests: ASTM C 39.
 - a. Test one cylinder specimen at 7 days for information, and remaining two cylinder specimens at 28 days for acceptance.
 - b. Deliver field-cured specimens to laboratory at 28 days and test to verify adequacy of curing and protection in field.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

3.20 EVALUATION OF TEST RESULTS

- A. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- B. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Architect, concrete supplier, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture 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 sole basis for approval or rejection of concrete.
- E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete at the expense of the Contractor when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- H. Fill core holes with concrete specified for location.

END OF SECTION 03 30 01

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment, and related services necessary to furnish and install all unit masonry as indicated on the Drawings or specified herein.

A. The following work is specified under separate sections:

1. Loose lintels and miscellaneous steel angles: Section 05 50 00 - Steel Fabrications.
2. Rod and sealant for control and expansion joints: Section 07 90 00 – Joint Protection.
3. Reinforcing : Section 03 30 00 – Concrete.

1.03 REFERENCES and STANDARDS

- A. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- B. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- C. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units
- D. ASTM C1262 - Standard Test Method for Evaluating the Freeze-Thaw Durability of Dry-Cast Segmental Retaining Wall Units and Related Concrete Units
- E. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's product information and data sheets for each product specified in this section, including:

1. Substrate preparation instructions and recommendations.
2. Installation means and methods.
3. Recommendations and requirements for proper storage and handling.

C. Shop Drawings:

1. Submit Manufacturer's approved shop drawings detailing the section and elevation views of each product to be installed.

2. Coordinate with locations listed on Contract Drawings.
3. Reinforcing: Provide drawings indicating reinforcing that complies with ACI 315 "Details and Detailing of Concrete Reinforcement".
 - a. Provide elevations indicating steel reinforcing bar placement.
 - b. Provide details indicating steel reinforcing bar sizes, placement, bends, and laps dimensions.

D. Warranty Information:

1. Submit confirmation and details of manufacturer's warranty, extended warranty, and replacement policies.

E. Submit product data for each type of product specified, including certification that each type complies with specified requirements.

F. Submit sample boards, cards or charts depicting available textures and colors for each CMU.

G. Mock-Up: Construct a mock-up using the selected stone and mortar materials to illustrate the appearance of the Work specified in this section.

1. The mock-up should be a nominal 36 inches x 36 inches (1m x 1m).
2. Construct the mock-up using the size, color blend, texture, joint size, and installation methods specified.
3. Architect and Owner's Representative must approve the mockup prior to commencement of Work.

1.05 QUALIFICATIONS

Installer: Company specializing in performing the work of this section with a minimum of five years' experience.

1.06 MOCK-UP

Sample Panels. Before starting masonry work, construct a sample wall panel at the project site of concrete block and mortar for approval of the Architect. Each panel shall be approximately 4 feet long by 3 feet high and shall represent the proposed color range, blend, texture, bond, mortar, and workmanship. Do not start masonry work until sample panel has been improved and approved by the Architect.

1.07 ENVIRONMENTAL REQUIREMENTS

Lay no masonry when the outside air temperature is below 40 degrees F. or expected to fall below 40 degrees F., unless sand and mixing water are heated to provide a mortar temperature of 70 degrees F. and the completed work is protected from freezing. Maintain an air temperature of 40 degrees F. on both sides of the masonry for at least 24 hours after the masonry work is completed.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver and handle all material in a manner to prevent damage. Store masonry units and packaged material above ground on wood pallets and protect from weather. All damaged materials shall be removed immediately from the site.

PART 2 – PRODUCTS

2.01 FOUNDATION BLOCK CMU

Acceptable manufacturers: Amcon Concrete Products, Echelon, Cemstone or approved equal.

All concrete masonry units shall be autoclave cured. Masonry materials shall be modular dimensioned, unless otherwise specified. Provide special shapes for 90-degree corners, bond beams, lintels and as indicated on the Drawings or otherwise required for a complete installation.

Concrete Block shall be normal weight concrete block manufactured from sand-gravel aggregate conforming to ASTM C90, Grade N, Type 1 units.

2.02 EXTERIOR WAINSCOTT CMU

A. Acceptable manufacturers: Echelon or approved equal.

B. General / Appearance: Pre-finished, architectural concrete block meeting the requirements of ASTM C90. One or more faces are ground to emulate a smooth terrazzo finish. A factory-applied clear satin gloss acrylic enhances moisture resistance.

- Basis of Design Product: Trendstone Plus® concrete masonry units, from Echelon

C. Color:

- As selected from manufacturers standard color range.

D. Dimensions: Locations and installation pattern as noted in the Contract Drawings.

- Type 1: Monumental Unit 412F24 (nominal 4"D x 12"H x 24"W)
- Type 2: Monumental Unit 4F24 (nominal 4"D x 4"H x 24"W)

2.03 MORTAR MATERIALS

- Provide site-mixed mortar that meets or exceeds the requirements of ASTM C270 Type S.
- Mortar must include manufacturer approved compatible integral water repellent addition added to each batch in the dosage rates for mortar type specified.
- **Colored Mortar:** For work above grade add coloring agent to the mortar according to the manufacturer's recommendations. Coloring agent shall be Davis Colors, Spec Mix, and other manufacturers approved by the Architect.
- **Mixing:** Accurately measure mortar materials by volume. Use a drum-type mixer. Mix sand, lime, and cement dry to a uniform color. Add water to bring mortar to proper consistency for use. Mix for at least 3 minutes after water is added. Thoroughly clean mixer after discharging each batch.
- Use mortar within 2-1/2 hours after initial mixing, and discard mortar not used within this time. Mortar may be retempered by adding water and remixing at any time within 2 hours after initial mixing.

2.04 MIXES

- A. Portland Cement: Conforming to ASTM C150 Type I, Type II or Type III as required to achieve optimal results based on ambient project conditions.
- B. Hydrated Lime: Conforming to ASTM C207, Type S.
- C. Aggregates: Conforming to ASTM C144 for mortar and ASTM C404 for grout.
- D. Pigments: Conforming to ASTM C979. Comply with quantity limitations in referenced standards and from the pigment manufacturer.
- E. Admixtures: Comply with quantity limitation specified ASTM C1384 "Standard Specification for Admixtures for Masonry Mortars" when adding to mortar.
1. Cold Weather: Comply with ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
 2. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength
- F. Water: Potable; Clean and drinkable.

2.05 REINFORCING, ANCHORS AND TIES AND MISCELLANEOUS MATERIALS

- Zinc coating of flat metal shall conform to ASTM A153-2, Class B-1, B-2, or B-3 as applicable. Zinc coating of wire shall conform to ASTM A116-81, Class 3.
- **Reinforcing Bars:** Deformed billet steel bars conforming to ASTM A615-09, Grade 60.
- **Joint Reinforcing for interior concrete block walls shall be as follows:**
- Concrete Block Walls: A.A. Wire BLOK-TRUSS, Standard, or Dur-O-Wall DUR-O-WALL TRUSS DESIGN, Standard.
- Longitudinal rods shall be mill finish, and cross rods shall be galvanized. Provide corners and tees.
- **Anchors for flexible anchoring of intersecting walls:** 2" x 5" x 1/4' mesh 23 ga. hardware cloth, ASTM A116, class 3 galvanized. Locate 16" o.c. vertically in mortar joints.
- **Anchors for rigid anchoring of intersecting walls:** 1/4" x 1/4" x 28" galvanized tie bars with 2" right angle bend in each end. Locate 4'-0" o.c. vertically and grout bent ends into single cores. Support grout on galvanized metal lath under cores. Rake out vertical joints on both sides for sealants.
- **Membrane Flashing:** Shall be a 12-mil thick film of high-strength cross-laminated polyethylene bonded to a 32 -mil (min.) layer of rubberized asphalt compound. Flashing shall be Dur-O-BARRIER DA1544 FLASHING, AIR SHIELD by WR Meadows, SAFESEAL 6634, or equal as approved by the Architect.
- **Building Paper (Bond Breaker):** #15 asphalt saturated felt.
- **Block Vents:** Dur-o-wall DA 1006 CELL VENTS, Jumbo size, Color: CLEAR (Transparent)
- **Cleaning Solutions:** Non-acidic, not harmful to masonry or adjacent materials.

- **Expansion joint material:** Dur-O-Wall RAPID SOFT-JOINT/ EXPANSION JOINT or equal as approved by the Architect.

2.06 GROUT MIXING

Thoroughly mix grout ingredients in quantities need for immediate use in accordance with ASTM C476 - Fine Grout. Add admixtures in accordance with manufacturer's instructions. Do not use anti-freeze compounds.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are properly prepared to receive concrete masonry units.
- B. Verify that bearing elements are within tolerances conforming to the requirements of ACI 117.
- C. Verify that locations of penetrations, projections and built-in items are correct and properly prepared for work specified in this section.
- D. Verify concrete brick masonry units are according to project specification and meet appropriate ASTM specification requirements. Commencement of installation constitutes acceptance of Concrete Face Brick, Concrete Masonry Units, Concrete Masonry Veneers, and Concrete Thin Veneers.
- E. Preparation: Prepare surfaces and materials in accordance with MSJC Specifications for Masonry Structures. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
- F. Provide adequate lighting for masonry work by placing all lighting at a reasonable distance from the wall for even illumination.

3.02 PREPARATION

- A. Proceed with installation only after substrate(s) are been properly prepared and within tolerances recommended by the manufacturer.
- B. Commencement of installation constitutes acceptance of site conditions.
- C. Draw blocks from more than one pallet at a time during installation.
- D. Refer to NCMA TEK Notes, for hot and cold weather construction practices.

3.03 INSTALLATION

- A. Cutting: Make all unit cuts, including those for bonding, holes, boxes, etc., with motor-driven masonry saws, using either an abrasive or diamond blade. Cut neatly and locate for best appearance.
- B. Concrete Masonry Units:
 - 1. Install concrete masonry units in accordance with industry accepted masonry practices and manufacturer's instructions.
 - 2. Bond Pattern: As indicated on Construction Drawings.

3. Do not use masonry units with broken corners and edges in excess of ASTM C90 and ASTM C1634.
4. Supporting and Forms: Construct forms as needed to adequately and safely support installed concrete masonry units until mortar has cured.

C. Mortar Bedding and Jointing:

1. Lay units with full mortar coverage on head and bed joints taking care not to block cores to be grouted or filled with masonry insulation.
2. Tool all joints into a concave configuration when mortar is thumbprint hard.
3. Remove mortar from the face of masonry units before it sets.
4. Tuckpoint joints of scored units for proper appearance and to prevent water penetration. Rake joints are not permitted and will be considered defective work.

D. Flashing: Install flashing at locations shown in the plans and in strict accordance with Construction Drawings, manufacturer's instructions and accepted best practices for masonry flashing.

E. Weeps and Vents: Install weep holes and vents at proper intervals at courses above grade and at any water stops over windows, doors and beams. Consult NCMA TEK notes for proper flashing and drawings.

3.04 FLASHING

- A. All flashing and accessory detailing components must be corrosion resistant.
- B. Verify that all flashing, including adjacent roof flashing, has been properly installed. Extend flashing material above horizontal terminations, roofing material, drainage planes or drainage products.
- C. Integrate all flashing materials with moisture resistive barriers to prevent water penetration into structure. Lap water resistive barriers over weep screed flanges in a water shedding fashion.
- D. Control Joints: Determine if and where Control joints are needed. Consideration should be given to where differential movement is expected or where movement may be concentrated. Refer to NCMA TEK 10-02C for guidance on control joint locations.

3.05 INSPECTION AND CLEANING

- A. Faces must conform to the requirements of ASTM C90 when viewed from twenty (20) feet at right angles to the wall with normal lighting.
- B. Keep work surfaces clean during installation. Use brushes, rags and burlap to remove excess mortar lumps and smears prior to hardening on the finished surfaces.
- C. Refer to Manufacturers recommendations for cleaning instructions for installed veneers.

End of Section

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Structural steel framing members and all related accessories such as structural embeds, connections, bolts, welds, fasteners, threaded rods, headed studs, including fabrication, erection and all related work and accessories.
 2. Connections and other performance specified items, including related design by contractor's specialty structural engineer.
 3. Temporary bracing and shoring, including related design by contractor's specialty structural engineer.
 4. Shop applied finishes and coatings, including preparation, primers, special paint systems or galvanizing on steel exposed to exterior or aggressive environments, and bitumastic coating on steel below grade in soil.
- B. Related Requirements:
1. Division 03 Section "Concrete" for items attached to formwork, anchors and embeds to be cast in concrete.
 2. Division 04 Section "Unit Masonry" for items attached to masonry, anchors and embeds to be set in masonry.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303, that support design loads, and as indicated on the structural contract documents.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written 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.
- C. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

1.4 ACTION SUBMITTALS

- A. Product Data:
1. Structural-steel materials.

2. High-strength, bolt-nut-washer assemblies.
 3. Anchor rods.
 4. Threaded rods.
 5. Shop primer.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Submit shop drawings under provisions of Division 1 Section "Submittal Procedures". Phase submittals to match sequence of actual construction to avoid delay of work. Field verify all existing conditions impacting this work and add relevant field information to shop drawings, prior to submittal of shop drawings.
 2. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, fasteners, loads, welds, and headed studs. Cut erection details where details are cut on structural plans and add erection details as needed. Provide erection plans, erection details and member detail sheets. If partial area submittals are made, submit all related sheets and cloud related plan areas. Reference specific structural plans and details from which information is drawn or submittals will be rejected.
 3. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 4. Include embedment Drawings.
 5. Provide setting drawings, templates and directions for the installation of the anchor rods and other anchoring devices, including embedments.
 6. 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.
 7. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.5 QUALITY ASSURANCE

- A. Fabricator shall have a minimum of 5 years experience in the fabrication of structural steel framing.
- B. Installer Qualifications: A qualified installer who has a minimum of 5 years experience in the erection of structural steel framing.
- C. Contractor shall assign a qualified staff member to perform quality control on their own work in the field on a daily basis, for each day work is performed. The Contractor's quality control staff shall review their own work for compliance with contract documents before the Contractor notifies the design team or others, of readiness for required inspections, tests and observations to be provided by the Owner's Representatives.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
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/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

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 F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.
- C. Deliver anchor rods and other anchorage devices to be embedded in concrete or masonry construction to site in time for installation without impact on schedule. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Provide material indicated below except where higher grade material is explicitly shown on drawings.
- B. W-Shapes: ASTM A992/A992M.
- C. Channels, Angles: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C.
- F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 - 1. Weight Class: Standard.
 - 2. Finish: Black except where indicated to be galvanized.
- G. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- H. Steel Forgings: ASTM A668/A668M.
- I. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

- B. Post-installed anchors: Provide post-installed anchors of type and embedment as indicated on drawings and general notes.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
- 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.

Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- F. Orient weld seams of all exposed HSS columns to reduce visibility.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Verify dimensions that affect the new work including gridlines, column and beam centerlines, face of wall, etc.

2. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- 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 on Drawings.
1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing 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 in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant 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 grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- 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 are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
- E. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- F. No trades may field cut or alter structural members without specific approval of the Structural Engineer. Submit dimensioned plan and detail sketch of proposed modification under cover of an RFI or cloud proposed changes on shop drawings.
- G. Coat all steel below grade with bituminous protection coating per manufactures instruction.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - a. Contractor shall remove all weld slag using pick and brush to expose bright steel for self-verification of workmanship by the contractor and for Quality Assurance access by testing agency. This shall be done on a daily basis as welding proceeds.
- C. Tension Control Devices:
 - 1. Install using electric power wrench as recommended by bolt manufacturer.
 - 2. cturer.
 - 3. Tighten until splined end of bolt is sheared off.
- D. Post-installed Anchors: Install according to manufacturers published instructions and as indicated on drawings.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to provide special inspections and testing services and prepare reports in accordance with Division 1, Section "Structural Tests and Special Inspections", and with IBC Chapter 17 and other items which in the professional judgement of the Structural Engineer of Record, are critical to the integrity of the building structure.
- B. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections as indicated under "Special Inspection and Testing Criteria."
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

3.6 SPECIAL INSPECTION AND TESTING CRITERIA

- A. General
 - 1. If special inspection of fabricators work is required in the shop, testing agent may test and inspect structural steel at plant before shipment. Owner and SER reserve right to reject material not complying with Contract Documents at any time before final acceptance.
- B. Definitions
 - 1. Refer to Division 1, Section "Structural Tests and Special Inspections" for standard requirements.
 - 2. A.S.N.T.: The American Society for Non-destructive Testing
 - 3. N.D.E.: Non-destructive Evaluation
 - 4. A.W.S./C.A.W.I.: American Welding Society / Certified Associate Weld Inspector
 - 5. A.W.S./C.W.I.: American Welding Society / Certified Weld Inspector
 - 6. Special Inspector – Technical: Shall be employed by a testing agency and shall be supervised by an A.W.S./C.W.I. with a minimum of 10 years experience, or an A.S.N.T. Level III with a minimum of 10 years experience. These individuals shall satisfy the following requirements:

- a. Technical I: Non-destructive Testing Technician A.S.N.T.-TC-1A Level I, and/or A.W.S. Certified Associate Weld Inspector (C.A.W.I.)
 - b. Technical II: Nondestructive Testing Technician A.S.N.T.-TC-1A Level II (NDE Technician II), A.W.S./C.A.W.I. with minimum 3 years experience, or an A.W.S./C.W.I
 - c. Technical III: A.S.N.T. Level III with a minimum of 10 years experience or an A.W.S./C.W.I with a minimum of 10 years experience.
7. Special Inspector – Structural
- a. Structural I: Graduate civil/structural engineer, or other personnel acceptable to the SER, with experience in the design of structural systems of this type. Inspections shall be performed under the direct supervision of a licensed civil/structural engineer.
 - b. Structural II: Civil/structural engineer regularly engaged in the design of structural systems of this type, licensed in the state in which the project is located. The licensed engineer shall review and approve all inspection reports.
 - c. Special Inspector – Structural may be an employee of the SER.
- C. Special Testing and Inspection Requirements
- 1. High Strength Bolting (Field Installed).
 - a. General (Technical II)
 - 1) Visually inspect mating surfaces and bolt type for all slip-critical bolted connections for general conformance with the contract documents prior to bolting.
 - 2) Determine the requirements for bolts, nuts, washers, paint and installation/tightening standards are met.
 - 3) Observe calibration procedures when such procedures are required in the contract documents and verify that selected procedure is used to tighten bolts.
 - b. Slip Critical Bolts and Tension Bolts (Technical II)
 - 1) Test bolt tightening in 10% of all bolts. Test a minimum of two bolts in each connection. Verify that all plies of connected elements have been brought into contact, at 100% of connection. Verify all tips are removed from “twist-off” bolts.
 - c. Bearing Bolts (Technical II)
 - 1) Visually inspect to conform all plies of connected elements have been brought into contact, at 100% of connections. (Applies only to bolts designed for values not requiring exclusion of threads from failure plane, all other bolts require testing as for tension bolts.)
 - d. Standard
 - 1) Test High Strength bolted connections per R.C.S.C. Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - 2. High Strength Bolting (Shop Installed) (Technical II)
 - a. For shop fabricated work, perform tests required for field installation, except that bolt testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
 - 3. Welding (General): The Special Inspector shall perform the following (Technical II):
 - a. Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to SER.
 - b. Verify qualifications of all welders as AWS certified.
 - c. Verify proposed welding procedures and materials.
 - d. Verify adequate preparation of faying surfaces.
 - e. Verify preheat and interpass temperature of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
 - 4. Welding (Field)
 - a. Fillet Welds (Technical II)

- 1) Visually inspect 100% of all fillet welds for size, length and quality per AWS D1.1.
- b. Partial Penetration Welds (Technical II)
 - 1) Test 100% of all partial penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
- c. Full Penetration Welds (Technical II)
 - 1) Test 100% of all full penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all full penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
- d. Stud Shear Connector Welds (Technical I)
 - 1) Visually inspect 100% of installed studs for full 360 degree flash. Test all questionable studs, not showing full 360 degree flash by bending studs 15 degrees from vertical, away from weld discontinuity, per AWS D1.1. All ceramic welding ferrules shall be removed by contractor. Randomly test all other studs by bending to 15 degrees from vertical as noted:
 - a) Studs welded through deck: 15%
 - b) Studs welded to bare steel: 5%
 - c) Alternatively, sound 100% of installed studs, for full penetration weld, using an 8 lb. Maul. Test questionable studs as noted above. Welding ferrules need not be removed.
- e. Deck Welds and Fasteners (Technical I)
 - 1) Visually inspect size, location, length and burn through for 100% of puddle welds on metal deck designed as a structural element, per AWS D1.3.
 - 2) Visually inspect sidelap fasteners to meet spacing and size specified.
- f. Welding of Reinforcing Bars (Technical II)
 - 1) Be continuously present during welding and visually inspect 100% of all reinforcing bar welds as the welding is performed, per AWS D1.4. Verify proper joint preparation is provided and proper electrodes are used and properly store and dried.
5. Welding (Shop)
 - a. Perform inspections as for field welding except weld testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
6. Mechanical Fasteners (Misc.)
 - a. Fasteners (Technical I)
 - 1) Visually inspect specified size, spacing, embedment, and location of expansion bolts and adhesive bonded bolts in connections shown on the structural drawings.
7. Structural Configuration
 - a. Submittals (Structural I)
 - 1) Verify mill test reports and other submitted documentation for compliance with contract documents.
 - b. Materials (Technical I)
 - 1) Verify materials delivered to site comply with contract documents and approved shop drawings. Materials include bolts, electrodes, mechanical fasteners and deck gauge.
 - c. Detail Compatibility (Structural I) On a periodic basis:
 - 1) Review project documents affecting integrity of the structure, including contract documents and pertinent submittals (approved shop drawings)
 - 2) Visit site, at intervals appropriate to the stage of construction, to perform review of the structure and visually confirm general compliance with the project documents.

- 3) Inspect the following to verify member orientation, configuration, type and size comply with details indicated on the contract documents and approved shop drawings:
 - a) Bracing and stiffening members
 - b) Proper applications of joint details at connections for structural members.
 - c) Other work critical to the integrity of the building structure.

- D. Conventional Testing and Inspection Requirements
 - 1. High Strength Bolting
 - a. Bolt Material Test (Technical II)
 - 1) Test a minimum of two bolts of each ASTM class specified, for bolt hardness and tensile properties.
 - b. Fabrication and Erection Tolerances (Owner's Construction Manager)
 - 1) Verify in-place structure satisfies specified tolerances

3.7 PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 12 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all metal fabrications indicated on the Drawings or specified herein.

The work of this Section includes, but is not limited to:

1. Loose lintels indicated on the Architectural Drawings.
2. All other items of miscellaneous iron and steel not specified under other Sections.
3. Site equipment protection bollards.

The following work is specified under other Sections.

1. Metal brackets and supports for counters: Section 06 40 00 - Architectural Woodwork.

1.03 STANDARDS

Structural work shall conform to the following standards, unless otherwise specified herein:

American Institute of Steel Construction (AISC) "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," Latest Edition, including Commentary.

American Welding Society (AWS) "Structural Welding Code", D1.1, Latest Edition.

Steel Structures Painting Council (SSPC) "Steel Structures Painting Manual," Volume 2, Systems and Specifications, Latest Edition.

1.04 SUBMITTALS

Shop Drawings. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Submit Shop drawings for approval (see Section 01 33 00, Submittals.)

PART 2 - PRODUCTS

2.01 MATERIALS

Metal shall be new, of the best commercial quality for the purpose intended and free from defects impairing strength, durability and appearance.

Miscellaneous Steel. Steel for miscellaneous structural framing and non-structural purposes shall be as follows:

Structural steel shapes, plates and bars: ASTM A36.

Carbon Steel plates, shapes and bars: ASTM A283.

Zinc Coating (hot dip) on Assembled Steel Products: ASTM A386.

Hot formed welded and Seamless Carbon Steel Structural Tubing: ASTM A501.

Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes: ASTM A500.

Fasteners: Bolts, nuts, washers and other fasteners ASTM A153

2.02 MISCELLANEOUS MATERIALS

Cold galvanizing shall be Sealube ZRC or Welco COLD GALV.

Non-shrink grout shall be Euclid EUCO N-S GROUT, Master Builders MASTERFLOW 713 grout, Sonneborn SONOGROUT or U.S. Grout Company FIVE-STAR GROUT.

2.03 FABRICATION

Structural members shall be designed and fabricated according to AISC "Specifications". Shop connections may be welded or bolted. Field connections shall be bolted.

Metal fabrications in finished spaces or exposed areas, shall be considered ornamental metal. Metal shall be smooth and free of surface blemishes including roughness, pitting, roller and seam marks and rolled trade names.

Members shall have clean, straight, sharply defined profiles. Shearing and punching shall leave clean and true lines and surfaces.

Joints shall be detailed so as to maintain the strength and rigidity of adjoining members. Generally, shop joints shall be welded. Use concealed welds where possible. Locate exposed welds in the least conspicuous place, and weld continuously. Grind exposed welds smooth and flush.

Shop connections where so detailed and all field connections shall be bolted using bolts or machine screws of adequate size. Use countersunk, Phillips, flat or oval headed machine screws for exposed bolted connections in finished spaces.

Exposed joints shall be neat, hairline joints with matching surfaces.

Work shall be shop assembled ready for erection as soon as possible. Where field joints are required, completely assemble the work in the shop to assure accurate fit and then disassemble for shipment.

Provide reinforcing required at connections and hardware locations. Do all mortising, drilling, punching and tapping required for attachment or hardware or attachments to other work. Provide anchors, clips, brackets and other accessories necessary for complete erection of this work and attachment of the work of other trades.

2.04 FINISH

Steel: Remove loose mill scale and rust from structural steel and remove all mill scale and rust from ornamental metal. Thoroughly clean to remove all oil, grease, dirt and other foreign material and apply one coat of rust inhibitive primer containing at least 50% rust inhibitive pigments. Paint shall be carefully applied to provide a smooth and even surface.

2.05 MISCELLANEOUS

- A. Plastic bollard covers:
- Uline or approved equal,
 - Size: 8" diameter post cover,
 - Color: Yellow
 - Rated for outdoor use and durability

PART 3 - EXECUTION

3.01 ERECTION OF MISCELLANEOUS METAL

Miscellaneous metal shall be erected by skilled mechanics experienced in the erection of ornamental and miscellaneous metal fabrications.

Work shall be erected plumb, true and square and securely attached to supporting construction. Field joints shall be neat, hairline joints with adjoining surfaces in alignment. The completed installation shall be secure and rigid with sufficient strength to support the loads.

Immediately after erection, clean welds, scratches and other abraded surfaces and touch up with the same paint used for the prime coat.

End of Section

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all Rough Carpentry as indicated on the drawings or specified herein.

The following work is specified under separate Sections:

1. Interior casework and millwork: Section 06 40 00 - Architectural Woodwork.
2. Concrete formwork: Section 03 30 00 - Cast-in-Place Concrete.

This Section includes but is not limited to:

1. Miscellaneous wood and wall framing and wall sheathing.
2. Wood blocking.

1.02 REFERENCES

1. ALSC: American Lumber Standards Committee: Softwood Lumber Standards.
2. APA: American Plywood Association.
3. AWP0A: American Wood Preservers Association; C1 - All Timber Products Preservative Treatment by Pressure Process.
4. NFPA: National Forests Product Association.
5. SPIB: Southern Pine Inspection Bureau.
6. WCLIB: West Coast Lumber Inspection Bureau.
7. WWPA: Western Wood Products Association.

PART 2 - PRODUCTS

2.01 LUMBER

Lumber shall conform to U.S. Product Standard PS20-70 and shall be grade stamped by an agency certified by the board of review of the American Lumber Standards Committee. Lumber shall be new, sound and thoroughly seasoned.

Moisture content of dimension lumber 2" or less in thickness shall be 19% or less at the time of installation and moisture content of finish lumber shall be not less than 14%. Lumber shall be dressed S4S, unless otherwise specified. Grades and species of lumber shall be as indicated on the drawings, and as follows:

Blocking, nailers, blind fascia, and framing lumber: Standard light framing grade Douglas Fir larch, Douglas Fir (South) Hem-Fir, Spruce-pine-Fir, Western Hemlock or other approved and comparable wood.

Boards: No. 2 and Better Common or Construction Grade Ponderosa Pine, Sugar Pine, or other approved and comparable wood.

2.02 PLYWOOD

Plywood shall conform to "U.S. Product Standard for Construction and Industrial Plywood", PS 1 - Latest. Performance rated panels shall conform to the applicable American Plywood Association (APA) performance standard contained in the "Performance Standards and Policies for Structural-use Panels", Form No. E445, November, 1982. Panels shall bear the appropriate APA Trademark.

Plywood with any face or edge permanently exposed to the weather shall be Exterior Grade.

Grade and type shall be as follows:

Roof Sheathing (above interior additions): APA Rated Sheathing, Exposure 1, 24/16, all veneer plywood, 5/8" thick as shown on drawings.

Interior plywood: Used under counter-tops, moisture resistant 3/4"

2.03 NOT USED

2.04 ROUGH HARDWARE

Provide rough hardware of the proper size, type and strength for the intended use and the material to be fastened. Use non-corrosive, non-staining rough hardware for exterior applications.

Rough Hardware shall conform to the appropriate Federal Specifications.

Provide anchor bolts indicated on the drawings or otherwise required to attach wood plates and bucks to concrete. Bolts shall be 1/2" in diameter and threaded one end with a 1.5" right-angle bend on the opposite end. Coordinate installation of bolts with masonry or concrete Contractors and deliver to the site promptly to be built in as the work progresses.

2.05 PRESERVATIVE TREATMENT

Lumber and plywood listed below shall be pressure impregnated with a water-born preservative in accordance with the American Wood Preservative Bureau (AWPB) Standard LP - 2-80.

1. Lumber used as plates in or on exterior walls.
2. Lumber or plywood where indicated on the drawings to be preservation treated.
3. Lumber or plywood used for fascias, cants, nailers, or other purposes.

Fabricate lumber insofar as possible before treatment. Dry lumber to a moisture content of not less than 19% after treatment.

2.06 FIRE-RETARDANT WOOD AND PLYWOOD

Wood or plywood indicated on the plans to be fire-retardant shall be pressure treated in accordance with the American Wood Preservers Association (AWPA) Standard C27 with low hygroscopic interior type A retardant. Each board or panel shall be labeled by an approved testing agency. After treatment wood shall be dried to a moisture content of not more than 15%.

PART 3 - EXECUTION

3.01 WORKMANSHIP

Work shall be accurately constructed, square, true to required levels and lines and securely fastened and anchored to produce a sturdy, rigid system of sufficient strength to support the loads. Application of plywood shall be in accordance with the recommendations of the American Plywood Association.

Plywood sheathing over wood studs: Install plywood sheathing vertically. Edge joints shall occur over studs. Leave a 1/8" space between panel edges. Nail to studs using 8d coated nails 6" on center at panel edges and 12" on center at intermediate studs.

Plywood roof sheathing shall be blocked under all edge joints.

Blocking: Furnish and install wood blocking, bucks, nailers and similar items securely, accurately and ready to receive the intended finish.

Provide solid blocking as necessary for the proper installation of casework, millwork, mirrors, grab bars and toilet accessories, and similar items. Blocking for grab bars shall meet the requirements of the "Guidelines for Barrier Free Space" of the Americans with Disabilities Act.

Furnish and install wood curbs, cants, fascias, blocking and other similar items in conjunction with roofing and sheet metal work. Materials and installation shall meet the requirements of the roofing and sheet metal subcontractors.

Protect curbs, cants, and blocking with a weathertight covering until finishes are securely in place.

End of Section

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all finish carpentry as indicated on the Drawings or specified herein.

The following is specified under separate sections:

1. Counters, casework: Section 06 40 00 Architectural Woodwork.

1.03 PROJECT CONDITIONS

Do not install wood trim and other interior finish carpentry until interior concrete work, masonry, plastering and other wet applications are complete, the building is adequately ventilated and proper temperature and humidity conditions can be maintained during and after installation.

1.04 STANDARDS

Work shall conform to Architectural Woodwork Institute (AWI) "Quality Standards and Guide Specifications" Latest Edition. Hardwood shall conform to standards of NHLA: National Hardwood Lumber Association.

PART 2 - PRODUCTS

2.01 LUMBER MATERIALS

Hardwood lumber for sills, brackets, and other misc. trim: Graded in accordance with AWI, maximum moisture content 6%, premium grade red oak, dimensions as indicated on the plans. Wood material shall be provided in lengths so to minimize field joints.

2.02 FASTENERS

Fasteners shall be of the size and type suitable to the application with a plain finish in concealed locations and a US26D finish in exposed locations.

2.03 ACCESSORIES

Lumber for shimming and blocking shall be softwood lumber of any species.

Primer shall be an alkyd sealer.

Wood filler shall be a solvent oil-based filler, tinted to match the surface finish color.

PART 3 - EXECUTION

3.01 FABRICATION

Fabricate to AWI Custom Standards. Shop assemble work for delivery to site, permitting passage through building openings.

3.02 WORKMANSHIP/ INSTALLATION

Install work in accordance with AWI Premium Quality Standard. Work shall be installed by experienced finish carpenters. Work shall be erected plumb, true and square and in a substantial manner. Finished work shall be neatly installed, free of slivers, open joints and hammer and tool marks.

Blind nail finished work insofar as possible and set surface nails. Drill pilot holes in hardwoods for nails to avoid splitting. Miter external corners of moldings and trim and cope internal corners. Set exposed nailheads 1/16" below the wood surface and fill with wood filler flush with wood surface. Wood shall be sanded and prepped for transparent finish.

End of Section

SECTION 06 40 00 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of the Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all architectural woodwork indicated on the Drawings or specified herein.

This section includes the following work but is not limited to:

1. Plastic laminate Casework.
2. Solid Surfacing countertops and backsplashes

The following work is specified under other Sections:

1. Sinks / Lavatories: Section 22 40 00 – Plumbing.

1.03 STANDARDS

Millwork and Casework shall conform to the Architectural Woodwork Institute (AWI) "Quality Standards of the Architectural Woodwork Industry, Latest Edition, unless otherwise specified herein.

1.04 REFERENCES

1. American Plywood Association (APA), Plywood Grades and Specifications Guide.
2. PS-1 - Construction and Industrial Plywood.
3. PS-20 -American Softwood Lumber Standard.
4. PS-51 - Hardwood and Decorative Plywood.
5. PS-58 - Basic Hardwood.
6. NFPA - National Design Specification for wood construction.
7. West Coast Lumber Inspection Bureau (WCLIB), Standard Grading and Dressing Rules.
8. Western Wood Products Association (WWPA), Standard Grading Rules for Western Lumber.

1.05 SUBMITTALS

Shop Drawings: Submit shop drawings for approval (see Section 01 33 00, Submittals). Shop drawings shall indicate details of field splicing, layout fabrication details and installation details.

Samples: Submit samples of each wood species, veneer and hardwood lumber, which is to receive a transparent finish at the job site. Provide samples of manufacturer's complete range of colors and finishes for solid surfacing material for all cost groups.

1.06 PROJECT CONDITIONS

Do not install architectural woodwork until interior concrete work, masonry, plastering and other wet operations are complete, the building is adequately ventilated and proper temperature and humidity conditions can be maintained during and after installation.

PART 2 - PRODUCTS

2.02 MATERIALS – CASEWORK

Plastic Laminate shall conform to the National Electric Manufacturer's Association (NEMA) Publication Number LD 3-1980. Plastic laminate shall be Arborite or approved equal. Use General Purpose 50, .05" thick laminate for horizontal and high exposure surfaces. Use General Purpose 28, .030" thick laminate for vertical and other exposed surfaces as indicated. Colors, patterns and finishes shall be selected from the plastic laminate manufacturer's complete line of colors, patterns and finishes.

- P-LAM 1: Arborite, Woodgrain, Serene Oak, W495

Countertop backer: AWI Backer 20 (white)

Cabinet vertical, interior panels, shelving, back panels and other non-exposed panels: Medium density particle board with a white, melamine finish.

Doors, drawer faces and edges, and exposed faces of cabinets: Medium density overlay board (MDO) with a plastic laminate finish.

Miscellaneous framing lumber: Yellow Poplar.

Drawers: Medium density particle board with a melamine finish. Cover exposed edges with plastic laminate.

Cabinet Hinges: Blum "Clip" series concealed hinges, Grass or equal.

Wire pulls: 4" Stanley 4484 Aluminum or equal

Shelf clips: Metal with zinc finish for use with synchronized drilled hole system.

Drawer Glides: KV 1429 or equal, 100 lb., full extension.

Locks: National Cabinet Lock: #C8053 for doors and #C8060 for drawers. Provide locks on cabinet drawers and doors unless directed otherwise by the Owner.

Cord Grommets: Standard grommet shall be a SG, 2" overall diameter, 1-3/4" hole size, 1" deep ABS plastic with 3/4" cord slot. Color as selected by Architect. Manufactured by Doug Mockett and Co., Manhattan Beach CA. 90266 (213-318-2491) or equal.

Heavy Duty Brackets and Fixed Rod: KV 1195; anochrome finish.

2.03 SOLID SURFACING (COUNTERS, SILLS, BACKSPASHES)

Counters:

- HanStone Foundations quartz surfacing fabrication. 3cm thick.
- Pattern: Fusion, MV623
- Edge Profile: Eased

Backsplash

- HanStone Foundations quartz surfacing fabrication. 1.5 cm thick.
- Pattern: Fusion, MV623

Sills:

- HanStone Foundations quartz surfacing fabrication. 2 cm thick.
- Pattern: Fusion, MV623
- Edge Profile: Eased

2.04 ACCESSORIES

Door mutes, adhesive, nails, screws and other connecting devices suitable to specific installation requirements.

Bolts, nuts, washers, lags, pins and screws shall be of the size and type suitable to the application. Provide a US26D finish at exposed locations.

Steel shapes with-in millwork shall be ASTM A36 steel, prime painted.

Adhesive, nails, screws and other connecting devices suitable to specific installation requirements.

Manufacturer's standard bowl clips, panel inserts and fastener for attachment of undermount sinks/lavatories.

PART 3 - EXECUTION

3.01 FABRICATION

Fabricate counters, cabinets, benches, trim, and other architectural woodwork in accordance with recommendations of AWI, Premium Grade. Shop-fabricate items whenever possible. Use concealed fasteners wherever possible.

Shop-assemble items to allow for ease of transportation to the construction site including loading, unloading, and entrance into the building to designated area for installation. Coordinate work with trades.

Apply plastic laminate in full uninterrupted sheets consistent with manufacturer's sizes. Construct hairline joints. File edges at corners to provide smooth, even edges.

Construct counters to be scribed to walls.

Fabricate splashes and edge details as shown on the drawings.

Make cutouts for sinks and plumbing trim. Seal edges of cutouts.

Install and adjust hardware for complete and correct operation.

3.02 INSTALLATION

Inspect previous work of others to make sure that blocking has been installed and other surfaces are clean, plumb, and level, and ready to receive millwork and casework materials.

Install architectural woodwork according to AWI Quality Standards, Premium Grade.

Work shall be installed by experienced finish carpenters. Work shall be erected plumb, true and square and in a substantial manner. Finished work shall be neatly installed, free of slivers, open joints and hammer and tool marks.

Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units and countertops.

Secure undermount sinks/ lavatory bowls to countertops using manufacturer's recommended sealant and mounting hardware.

Blind nail finished work insofar as possible and set surface nails. Drill hardwoods for nails. Miter external corners of moldings and trim and cope internal corners.

Scribe countertops to walls.

Install shelving, rod and brackets following all manufacturer's recommendations and requirements.

End of Section

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

This Section includes all labor, material, equipment and related services necessary to furnish and install all hollow metal doors and frames indicated on the Drawings or specified herein.

The following work is specified under other Sections:

1. Final Painting: See Section 09 91 00 - Painting
2. Hardware: See Section 08 71 00 - Door Hardware
3. Glazing: Section 08 80 00 - Glazing

The following work is provided by the Contractor and must be coordinated with the work of this section:

1.03 REFERENCES

1. ASTM E152 - Methods of Fire Tests of Door Assemblies.
2. DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's hardware.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA - Fire Tests for Door Assemblies.
5. ANSI/SDI A250.8 – SDI-100 - Standard Steel Doors and Frames.
6. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames (formally SDI-105).
7. UL 10B & UL 10C - Fire Tests of Door Assemblies.
8. ASTM A924 – A60 zinc coating on cold rolled steel.

1.04 QUALITY ASSURANCE

Conform to requirements of SDI - 100. Fire rated door and frame construction shall conform to UL 10B or UL10C. Installed frame and door assembly shall conform to NFPA 80 for fire rated class indicated in the Schedule.

1.05 SUBMITTALS

Shop Drawings. Submit shop drawings for approval (see Section 01300, Submittals.) Shop drawings shall include details of field splices, anchorage, frame configuration, location of cut-outs for hardware, reinforcement, and finish.

1.06 ENVIRONMENTAL CONDITIONS

Store frames and doors off floors and ground and cover to prevent rust or other damage. Cover should allow adequate ventilation of doors and frames and prevent build-up of humidity around frames. Separate frames with 1/4" air space minimum.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Steel frames shall be manufactured by Ceco, Curries, or Steelcraft.

One-piece hollow metal frames shall be Steelcraft F Series (2" wide face,) or comparable type of other specified manufacturers.

Doors shall be Steelcraft "L" series or comparable doors of other specified manufacturers.

2.02 HOLLOW METAL DOORS

Door Type 3 (exterior swing door): Steelcraft "L" Series, model L16, seamless, 1lb polystyrene core.

Exterior door construction shall comply with ANSI/SDI 100, Grade III – Extra Heavy Duty.

Door Type 4, 5 (interior swing door): Steelcraft "L" Series, model L18, seamless, honeycomb core.

Interior door construction shall comply with ANSI/SDI 100, Grade II – Heavy Duty.

To control heat loss, cores of exterior doors that are not located in vestibules may be constructed with face sheets laminated to a foam core. Such doors shall comply with ANSI/SDI 100, Grade III – Extra Heavy Duty.

Provide Flush watertight top closures for all exterior doors.

2.03 HOLLOW METAL FRAMES

Frame Construction: Steel frame construction shall comply with Steel Door Institute NCA standards ANSI/SDI 100, Grade II Type level for interior applications, Grade III for exterior applications, and as modified below.

All frames: Steelcraft "F" Series, model to comply with requirements herein.

All exterior and interior hollow metal door openings shall be one-piece frames.

Exterior frames shall be constructed of 14 gauge cold rolled steel.

Interior frames shall be constructed of 16 gauge cold rolled steel.

Exterior and interior frames shall be one piece, welded, unit type construction. Factory-assemble frames in as large sections as possible.

Breaks shall be accurately formed, true and sharp. Corners shall be square and in alignment. Corners excluding stops shall be fully mitered to hairline accuracy and all joints continuously electric welded in their entirety on the back side then all exposed surfaces ground smooth to hairline joints. Finished work shall be smooth and free from warps and buckles.

Provide stiffeners and reinforcing indicated on the Drawings or otherwise necessary to insure a rigid and secure installation.

Provide 16-gauge x 3 ½ inches floor clips for all frames. Provide six jamb anchors spaced not over 30" on center for all frames. Furnish temporary spreader bars and bracing.

Frames shall be thoroughly cleaned, phosphatized, and given one coat of factory-baked, rust inhibitive primer in conformance with ANSI A250.10.

The inside of the exterior and door frame profile and frames in interior masonry walls, shall be given one coat of bituminous coating to a thickness of 1/16".

Closed sections shall have full length internal reinforcement of 16-gauge steel, spot welded to both soffits at 8 inches on center.

2.04 PREPARATION FOR HARDWARE

Mortise, reinforce and drill and tap for mortised hardware, and reinforce for surface applied hardware. Mortise to hairline accuracy with no oversized punching. Reinforcement shall be as required in ANSI A250.6.

Reinforce frames with a 7-gauge steel plate at each butt hinge. Lock front and strike reinforcing shall be 16-gauge steel and prepared for ANSI-A115.1-2 strike. Reinforce frames for closers with a 14-gauge steel plate. Other reinforcing shall be not less than 12-gauge steel.

Cover mortises in frames with metal plaster guards or steel mortar boxes.

Furnish at least 3 rubber door silencers for each jamb and two for the head. Drill frames for door silencers.

PART 3 - EXECUTION

3.01 ERECTION

Install frames strictly according to the manufacturer's instruction. Frames shall be set plumb and true, properly aligned and rigidly and securely anchored in place.

Install one-piece frames in masonry walls before enclosing wall construction proceeds, and anchor with jamb anchors spaced not over 30" on center.

Install hollow metal frames following all recommendations of the manufacturer.

After erection, clean frames and touch up welds, scratches and other abraded spots with same paint as used for the prime coat.

End of Section

SECTION 08 36 13 - SECTIONAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

This Section includes all labor, material, equipment, and related services necessary to furnish and install insulated sectional door, operating hardware, and operator indicated on the Drawings or specified herein.

The following work is specified under other Sections:

1. Electrical: See Electrical Division Table of Contents

1.02 SUBMITTALS

Product Data Sheets, Shop Drawings and Samples

Shop Drawings: Plans, elevations, sections, mounting details, dimensions, components, wiring power, and signal diagrams.

Samples: colors of factory applied finishes

1.03 WARRANTY

2 YEARS: Materials and workmanship for panels, tracks, electrical components failure

10 YEARS: Factory applied finishes

1.04 PERFORMANCE REQUIREMENTS

General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

Design Wind Load: As indicated on Drawings.

Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Acceptable manufacturer shall be Wayne-Dalton, Eagan, MN or approved equal..

2.02 SECTIONAL DOOR

Provide an insulated steel door assembly with rabbeted meeting rails to form weathertight joints and provide full-width interlocking structural rigidity. Overhead Sectional Door.

Model: Wayne-Dalton Thermospan 200 insulated sectional overhead steel doors. Provide specific configuration with components as follows:

Panel Thickness: 2 inches (51 mm)

Exterior Surface: White Stucco (or custom color per Architect's decision).

Exterior Steel panels: 20-gauge, hot-dipped galvanized steel. Finish per manufacturer's nominal coated thickness.

Interior Sheet panels: Galvanized steel sheet with manufacturer's nominal coated thickness.

Spring Counterbalance: High cycle spring @ 25,000 cycles. Size to weight of door. Helically wound, oil tempered, mounted on a steel shaft.

Insulation: Foamed in place HCFC-free polyurethane.

Finish: Two-coat baked-on polyester

Color: Selected by Owner/Architect from standard color options.

Windows: Insulating Vision Glass per manufacturer's standard, size and spacing as shown on drawings.

Hardware: Heavy Duty, corrosion resistant

Lock: Interior mounted slide lock

Weatherstripping: Flexible PVC bulb-type strip on bottom section.

Jambs and Head: Flexible seals.

Operation: Electric Door Operator as follows:

Operator Type: UL listed, trolley, track mounted.

Speed: 2/3 to 1 foot per sec

Heavy Duty, 25 or more cycles per hour and more than 90 cycles per day

Interior side mounted push button control with open, close and stop buttons

Bottom sensing Edge self-monitoring type

Safety: UL 325 listing, for commercial/industrial use, moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.

Audible and visual signals

Emergency Manual Operation: Chain hoist

Track: Provide track enough to accommodate 2 inch door. Standard configuration.

Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

PART 3 - EXECUTION

3.01 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

Examine locations of electrical connections.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

Tracks:

Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.

Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

Power-Operated Doors: Install according to UL 325.

3.03 STARTUP SERVICES

Engage a factory-authorized service representative to perform startup service.

Complete installation and startup checks according to manufacturer's written instructions.
Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress. Test sectional door for proper operation and adjust as necessary.

Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.05 DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

3.06 CLEANING

Clean exposed surfaces using non-abrasive materials and methods as recommended by the manufacturer.

End of Section

SECTION 08 41 00 – ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all Aluminum storefront doors and frames indicated on the Drawings or specified herein.

The following work is specified under other Sections:

1. Cylinders: Section 08 71 00 – Door Hardware.
2. Caulking of joints between aluminum frames and surrounding construction: Section 07 90 00 - Joint Protection.
3. Glass: Section 08 80 00 - Glazing.

1.03 REFERENCES

AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications.

AAMA 606.1 - Specification and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.

AAMA 607.1 - Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.

AAMA 608.1 - Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

AAMA SFM-1 - Aluminum Storefront and Entrance Manual.

ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

ASTM E-283 – Air Performance

AAMA 501.1 – Dynamic Water Penetration

1.04 SUBMITTALS

Shop Drawings. Submit shop drawings for approval (see Section 01 33 00 – Submittal Procedures.) Show dimensions, locations, elevations, sections, opening requirements and other details.

Samples. Submit sample of Anodized finish to the Architect for approval upon request. Samples shall indicate full range of color variation in the selected color.

Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, of aluminum framed storefront.

1.05 QUALITY ASSURANCE

Perform work in accordance with AAMA SFM-1 and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications.

Design Wind Loads: Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

- a. Basic Wind Speed (MPH): 120
- b. Risk Category: III
- c. Exposure Category: C

Storefront System Performance Requirements:

Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of 20 lbs./sq. ft. inward and 20 lbs./sq. ft. outward. The design pressures are based on the International Building Code; 2012 Edition.

Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.24 psf (300 Pa).

Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 10 psf (500 Pa) as defined in CSA A440 B5 Rating

Uniform Load: A static air design load of 30 psf (1437 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur. CSA A440 C2 Rating.

Thermal Transmittance (U-Factor): Trifab 601T not to exceed .47 (System) as determined by AAMA 507 or NFRC 100.

1.06 FIELD MEASUREMENTS

Verify that field measurements are as indicated on the Shop Drawings.

1.07 WARRANTY

Manufactures Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.

Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Doors and frames shall be manufactured by Kawneer, EFCO or U.S. Aluminum. The nomenclature used is based on a Kawneer Trifab 601T. Center Plane. **Source of Supply:** Local Kawneer Rep. is Steve Opheim 952.882.7854

2.02 MATERIALS

Extruded Aluminum: ASTM B221. Extruded section to have an anodized finish shall be extruded from a controlled aluminum alloy recommended for use with the anodized finish and having mechanical properties and temper equal to 6063-T6.

Fasteners for use with aluminum members shall be aluminum or non-magnetic stainless steel.

Steel for reinforcing and brackets shall conform to ASTM A36-84a. Steel shall be hot dipped galvanized. Galvanizing shall conform to ASTM A123-78, and zinc coating shall weigh not less than 2.0 ounces per square foot of surface.

Break Aluminum: Provide miscellaneous break aluminum, with the same finish as the aluminum frame, as indicated on the drawings or as required for a complete installation.

Sill Flashing: Provide sill flashing with the same finish as the aluminum frame as indicated on the drawings or as required for a complete installation.

Glass: See section 08 80 00.

2.03 FINISH

Exposed exterior aluminum surfaces shall be given a Clear (#14) anodized finish meeting the requirements of AA-M12 C22 A41. Finish shall be Architectural Class 1 - .7 mils minimum.

Exposed interior aluminum surfaces shall be given a Clear (#17) anodized finish meeting the requirements of AA-M12 C22 A31. Finish shall be Architectural Class II - .4 to .7 mils minimum. Concealed steel items shall be hot-dipped galvanized.

2.04 ALUMINUM FRAMES

Aluminum frames shall be **Kawneer Trifab 601T** Framing System or comparable type of other specified manufacturers that provide a similar package of accessories.

Frames shall be tubular aluminum sections designed for flush glazing. Frames shall be split construction with the exterior portion separated from the inner portion with a polyvinyl chloride separator. Thermal characteristics shall be at least equal to 1" insulating glass for exterior glass. Typical frames shall be 2" x 6" nominal size or as shown on the drawings. Glass: Exterior Glazed.

Tubular aluminum frame sections shall be designed to withstand a minimum wind load when glazed of 20 pounds per square foot normal to the surface. Individual members, including anchorage, shall be increased in size or reinforced as necessary to resist the loads without undue deflection.

Frames shall be factory assembled insofar as possible. Joints shall be accurately milled to produce hairline and watertight joints and shall be reinforced and mechanically joined with concealed devices. Finished work shall be neat in appearance, free of defects and rigidly joined.

Frames shall be glazed with POLYMER flush glazing inserts. Where glazing stops are required for special sections or are indicated on the Drawings, the glazing stops shall be snap-in type, extruded aluminum section with Polymer glazing inserts. Form neat, hairline joints.

Mortise, reinforce and drill and tap for hardware.

Provide stiffeners and reinforcing as indicated on the Drawings or otherwise specified or necessary to insure a rigid and secure installation.

Provide clips, anchors and other accessories. Provide temporary bracing.

Provide 1" aluminum sub-frames at doors where required by design.

2.05 ALUMINUM DOORS

Exterior Aluminum doors shall be 2-1/4" thick, **560 Insulclad Thermal** aluminum doors. Doors shall have nominal 5 9/16" wide stiles and top rail and a 12" wide bottom rail. 5 9/16" Cross rail. 1" insulating glass. Thermal Transmittance (U_Factor) : Door System not to exceed .77. Field Verify to match existing.

Doors shall be constructed of extruded tubular aluminum sections with a minimum wall thickness of 0.125." Corners shall be reinforced and welded, joined with mortise and tenons and steel tie rods or J-bolts, or both welded and mechanically fastened, as standard with the manufacturer. Weld shall be concealed and shall not damage the surface finish. Mechanical joints shall be accurately milled to produce hairline, watertight joints. Finished work shall be neat in appearance, free of defects and securely and rigidly joined.

Doors shall have adjusting mechanism to provide minor adjustments after installation.

Glazing stops shall be snap-in type, square, extruded aluminum sections with EPDM glazing inserts. Stops shall be not less than 0.050" thick. Stops shall be non-removable from the exterior side. Form neat, hairline joints.

Mortise, reinforce and drill and tap for hardware. Provide a 1/4" steel bar hinge reinforcement extending the height of hinge stile. Anchor butt type hinges directly to the continuous reinforcement.

Weatherstrip exterior doors with vinyl or 100% virgin wool pile weatherstripping inserted in a keyway type groove. Surface applied weatherstripping is prohibited.

PART 3 - EXECUTION

3.01 ERECTION

Install doors and frames strictly according to the manufacturer's instructions and recommendations.

Protect aluminum that comes in contact with concrete, masonry, steel and other dissimilar materials from galvanic and corrosive action with neoprene gaskets or a coat of bituminous paint applied prior to installation.

Erect frames plumb, level, true to line without warp or rack of frames within the manufacturer's prescribed tolerances. Provide support and anchor in a substantial manner. Form filled joints neatly.

Glass shall be outside glazed and held in place with extruded aluminum pressure plates. Water shall be drained to the exterior by using joint plugs and silicone sealant to divert water to the horizontal weep locations.

After doors and frames have been glazed, clean and protect, as required. Adjust hardware and leave doors in good operating order.

End of Section

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all finish hardware indicated on the Drawings or specified herein.

The following work is specified under other Sections:

2. Punching, machining or reinforcing for hardware: Section 08 71 00.
3. Installation of Doors and Hardware: Section 06 20 00 - Finish Carpentry.

The following work is included in the project and must be coordinated with the work of this section:

1. Doors and Frames: 08 11 13 – Hollow Metal Doors and Frames

1.02 QUALIFICATIONS

Hardware shall be supplied by an experienced builder's hardware contractor authorized by the manufacturer of the butts, locks, exit devices, closers, and door controls to sell the respective items of hardware being furnished for the Project. Submittals to be signed by an AHC having at least five years' experience in the Hardware Industry.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

Hardware to be mounted on doors required to have a UL label shall be listed by the Underwriter's Laboratories, Inc. (Guide GWTZ) for use with the appropriate labeled assembly. Where UL requirements conflict with the Drawings or Specifications, provide hardware conforming to UL requirements without additional cost to the Owner. Indicate conflicts and proposed substitutions in the hardware schedule.

Handicapped Requirements: 2020 State of Minnesota Accessibility Code

1.04 REFERENCES

ANSI A117.1 - Specification for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

BHMA (Builders Hardware Manufacturers Association) - A156 Series.

DHI (Door and Hardware Institute) - A115 series.

DHI - WDHS.3 - Architectural Hardware for Wood Flush Doors.

1.05 SUBMITTALS

Hardware Schedule: Submit hardware schedule to the Architect for approval. Provide product data for each type of hardware.

Check the specified hardware for suitability and adaptability to the details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in the hardware schedule.

Keying Schedule: Upon approval of the Hardware Schedule, submit a keying schedule to the Architect for approval.

1.06 SUBMITTALS AT CLOSEOUT

1. Record actual locations of installed cylinders and their master key code.
2. Provide maintenance data on operating hardware, lubrication requirements, and inspection procedures relative to preventative maintenance.
3. Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.
4. Submit Manufacturer's warranty and ensure forms have been completed in Owner's name and registered with the Manufacturer.

1.07 PREINSTALLATION SEMINAR

Before hardware installation, the prime contractor shall coordinate a hardware installation seminar (with a one-week notice) for all parties involved. The seminar is to be conducted on the installation of hardware, specifically locksets, closers, exit devices, continuous hinges, and overhead stops. The manufacturer's representative of the above products shall conduct the seminar. The seminar is to be held at the job site and attended by the intended installers of the hardware, including low voltage hardware, for aluminum, hollow metal, and wood doors. Training to include use of installation manuals, hardware schedule, templates, and physical products samples. All material suppliers shall supply maintenance manuals and parts lists for their respective items at the conclusion of the project.

1.08 POST-INSTALLATION WALKTHROUGH

The hardware supplier and manufacturer representative (locksets, closers, exit devices, and overhead stops) shall visit the project site after the hardware has been installed and shall notify the Architect if there is any hardware that has not been installed correctly. The Contractor and hardware supplier shall furnish the Architect with written certification to this effect. After the hardware is installed, the hardware supplier and manufacturer's representative shall meet with the Owner to explain the functions, uses, and maintenance of all types of hardware installed.

PART 2 - PRODUCTS

2.01 HARDWARE

Hardware shall be new and free from scratches, mars, and other defects. Hardware shall be furnished complete with accessories of proper size and design required for the purpose for which it is to be used **and** with all screws, shields, and other anchorage devices necessary for complete installation onto the supporting surfaces for which each item is intended.

2.02 ACCEPTABLE MANUFACTURERS

Hardware shall be manufactured by the following, unless otherwise specified:

Butts: Hager, Ives, McKinney.

Closers: LCN.

Coordinators: Ives, Door Control Int., Trimco.

Door Pulls/Push Bars/Push Plates: Burns, Hager, Ives.

Door Stops and Holders: Corbin, Glynn-Johnson, Ives, Russwin, Sargent or Quality

Exit devices: Von Duprin, Precision.

Flush Bolts: Ives (No substitutions)

Locks and Latches: Schlage (No substitutions)

Keying: Corbin Russwin Systems 7 pin

Kick Plates/Mop Plates: Burns, Rockwood or Ives.

Latch Protector: Mag, Don-Jo.

Overhead Stops: Glynn Johnson, Rixson.

Threshold/ Weatherstripping/Gasketing: Pemko, NGP, Reese, Zero, or Ultra.

Wall Stops/ Holders: Ives, DCI.

2.03 FINISHES

Butts:	US32D Exterior US26D Interior
Closers:	Powder coat aluminum
Coordinators:	Prime painted or mill alum.
Locksets and latchsets:	US26D (626)
Exit devices:	US26D with US32D Touch-Pad
Flush Bolts:	US26D
Magnetic Holders:	US2CD (603)
Magnetic Lock:	US28 (628)
Miscellaneous:	US26D on brass or bronze.
Overhead Stops:	US32D
Pulls/Push Plates/Bars:	US32D
Protective plates and trim:	US32D
Thresholds:	Mill Aluminum
Wall Stops/ Holders	US26D or US32D
Weatherstripping/Sweeps/Caps:	Duranodic

2.04 BUTTS AND HINGES

Acceptable manufacturers and equivalent types of butts shall be as follows:

<u>Type</u>	<u>Hager</u>	<u>Ives</u>	<u>McKinney</u>	
1	1279	5PB1	T2714	
2	BB1279	5BB1	TB2714	
3	BB1191	5BB1 630	TB2314	
4	BB1168	5BB1HW	T4B3786	
5	BB1199	5BB1HW 630	T4B3386	Stainless Steel
6	WTBB1199			Wide Throw

Size: For 1 - 3/4" doors: 4 - 1/2" x 4 - 1/2"

Numbers listed are template type for metal doors or frames. Non-template butts shall have flat bottom tips. Provide proper butt width to cleat trim and allow full 180 degree door swing.

2.05 CLOSERS

Acceptable type of manufacturers and equivalent types of exposed closers are as follows:

1. LCN 4111 and 4011 EDA
2. Norton Series 7500/ 7500BF
3. Sargent Series 281 (omit pressure relief valve)
4. Yale Series 4400/ 4400BF

Comply with ANSI A156.4-1994, Grade 1 Operational Standard. Size of closers for interior doors shall be in accordance with the manufacturer's recommendation for the individual door sizes and locations. Furnish closers larger than recommended by manufacture for interior doors where necessary for the proper operation of the door and to comply with ADA and ANSI A117.1. Provide a rack and pinon mechanism with adjustable controls on sweep, latch and backcheck speeds. Include a tamper-proof tool and an independent feature for adjusting the valve key. All closers to be through-bolt mounted.

Supply drop plates or adaptors for arms as required to suit details. Where wall conditions permit, doors shall swing 180 degrees. Closers shall be mounted on the back side of the door whenever possible and not exposed on the corridor side.

2.06 NOT USED

2.07 COORDINATORS

Ives COR, Door Control Int. 600, or Trimco 3094.

2.08 DOOR PULLS/PUSH PLATES/BARS

	<u>Burns</u>	<u>Hager</u>	<u>Ives</u>
Push/Pull Plate	54	30S 4 x 16	8200 14 x 16
3/4" Pull	25B	3G	8102-8

2.09 DOOR STOPS AND HOLDERS

	<u>Ives</u>	<u>DCI</u>
1.)	WS407CCV	3211T
2.)	WS11X	3260X
3.)	WS20X	-----

2.10 DOOR REINFORCER

Cylindrical Retrofit: MAG 4-S-2

2.11 ELECTRIC STRIKES

VonDuprin 6000 series or Folger Adam 300 series.

2.12 EXIT DEVICES

	<u>Von Duprin</u>	<u>Precision</u>
1.)	98 series	Apex 2000 series

All exit devices shall be U.L. listed for safety requirements, as well as listed for rated doors.

All dogging shall be done by hex key at all non-rated devices.

Provide rim exit devices whenever possible. No concealed rods or mortise devices allowed. If a vertical rod device is required, provide surface mounted rods. All doors receiving surface vertical rod devices to have through-bolt mounted latch cases.

Von Duprin's surface vertical rods to use the following:

- 98-006 Top vertical rod assembly
- 98-005 Bottom rod assembly
- 101648 Rod guide assembly
- 971348 LBR Latch return spring

2.13 FLUSH BOLTS

Ives

- | | |
|---------|----------|
| 1.) 458 | 4.) 51P |
| 2.) 31P | 5.) 61P |
| 3.) 41P | 6.) DP-2 |

2.14 LOCKSETS AND LATCHSETS

Mortise Locksets : Comply with ANSI A156.13-1994, Series 1000, Grade 1 Operational, Grade 2 Security and A117.1 Accessibility Code. A recognized independent testing agency must verify that lockset pass the cycle tests by exceeding 6 million test cycles.

Interior Lock and locksets to be one of the following manufacturers :

1. Corbin/Ruswin : Series ML2000, Lever Design – Armstrong – Verify in Field, match existing.
2. Sargent : Series 8200, Lever Design LE1 B

Commercial locksets, 3/4"inch throw latch bolt. Sets shall be of uniform size regardless of function, 2 3/4 inch backset, latch bolt minimum 1/2 inch throw, deadbolts shall be made of 1 1/2" stainless steel with a minimum 1 inch projection, cylinders shall have 6 pin tumblers. The lock spindle shall be designed to break away and fracture with a 120 pound load at the end of the lever. Cylinders to be as required by Owner's existing building key system.

Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8" beyond trim, frame or inactive leaf. See hardware groups for lock functions.

2.15 KEYING

Supply six keys for each masterkey group and six grandmaster keys.

Supply six construction keys to the Contractor.

All permanent cores to be shipped directly to the Owner. All keys shall have tags with room, lockset, number on the tag, packages in envelopes, marked with key identification.

Exterior: Corbin Russwin Systems 7 pin (IC) core-Premium System. Furnish a Cylinder on trim/pull side of all weather exposed door lock applications as specified in the Hardware Groups Section.

Interior: Corbin Access Systems Standard Cylinder 6 pin (to match existing building).

All cylinders are to be keyed per Owner's requirements. All cylinders to be (IC) interchangeable core. All interior door locks to have construction cores, as required by the Owner. All interior permanent cores to be as specified by the Owner.

2.16 KEY CABINETS

HPC Furnish key cabinet with a capacity 1.5 times the number of key sets.

2.18 KICK PLATES / MOP PLATES / ARMOR PLATES

Ives, Rockwood or Burns.

All kick plates shall 10" high and 2" LDW. All Mop Plates shall be 4" high and 2" LDW. Armor Plates shall be 16" high and 2" LDW. Thickness shall be (16 gauge) 0.050 inch. Plates shall have countersunk holes and beveled edges four sides.

2.19 LATCH PROTECTOR

MAG 8848 or Don-Jo LP-207

2.20 NOT USED

2.21 OVERHEAD STOPS

Glynn Johnson

- 1.) 90 Series
- 2.) 100 Series
- 3.) 450 Series

Rixson

- 9 Series
- 1 Series
- 10 Series

Use wall mount hold opens whenever possible. Wall magnetic holder's housing and armature shall be constructed of die-cast zinc material.

2.22 THRESHOLDS, WEATHERSTRIPPING, GASKETING

	National Guard	Reese	Pemko	Ultra
Thresholds:	1.) 425E	S205A	171A	TH015
Weatherstrip:	2.) 700NA	755A	2891APK	WSO53S
Gasketing:	3.) 2525	797B	S88D	WS280D
Drip Strip:	4.) 16	R201	346	WS025A
Sweeps:	5.) B606	964	18061CP	WS257A

Astragal: 6.) 125N 92C 305CN WS235A

Furnish head/jamb gaskets and edge stile astragals for pairs and all "S" rated doors whether listed in hardware groups or not. Provide material based on passing UL 10C, UBC test 7-2.

2.23 WALL STOPS AND HOLDERS

	<u>Ives</u>	<u>DCI</u>
1.)	WS407CCV	3211T
2.)	WS11X	3260X
3.)	WS20X	-----

PART 3 - EXECUTION

3.01 INSTALLATION OF FINISH HARDWARE

Hardware shall be installed by experienced finish carpenters. Install strictly according to the hardware manufacturer's installation instructions. Install hardware on labeled opening so as to maintain the label.

Fit hardware before final coat of paint or other finish is applied, and then remove hardware. Cut and mortise neatly. Evidence of cutting shall be concealed in the finished work. Permanently install hardware after finishing operations are complete and dry. Protect knobs and handles from scratching and other damage. Adjust hardware and leave in good operating condition.

Unless otherwise indicated on the Drawings, door hardware shall be mounted as follows:

Locksets/Latchsets: Mfr. standard.

Deadlocks: Center cylinder 48" above floor.

Door Pulls: Center to top bolt - 42" above floor.

Push bars: Center 42" above floor.

Door Stops: As near the strike edge of door as possible.

Kick Plates and Armor Plate: Door bottom with 1/2 inch clearance to door edges. Push side of door.

Door Holders and Closers: As recommended by the manufacturer for the degree of opening.

Panic devices: Center 38" above floor or as recommended by the Manufacturer.

3.02 KEYS

Manufacturer to send keys directly to Owner at the time of acceptance of the building.

3.03 HARDWARE

The following listing describes several hardware groups as a convenience to the hardware contractor but is not intended to be a complete tabulation of the work included, and such listing shall in no way limit the responsibility

of the hardware contractor to furnish all items shown on the Drawings, specified above or reasonably incidental to the completion of the work of this Section.

Group 1: Exterior Hollow Metal Doors: 100A, 102B, 108B

Each door shall have:

1 ½ PR Butts	Type 4	(As specified)	
1 Mortise Lockset	8237	Sargent	
1 Closer	4111		
2 Kick plates			
1 Seals	National Guard Products	5050CL	CLR
1 Drip Cap	National Guard Products	16A	Alum
1 Door Sweep	National Guard Products	C627A	Alum
1 Threshold	National Guard Products	613	Alum

Group 2: Interior Hollow Metal Doors: 102A, 105, 106B, 107, 108M

Each door shall have:

1 ½ PR Butts	Type 4	(As specified)	
1 Mortise Lockset	8237	Sargent	
1 Closer	4111		
1 Wall/floor stop	As specified		
2 Kick plates			

Group 3: Interior Privacy Doors (Restrooms): 103, 104

Each door shall have:

1 ½ PR Butts	Type 4	(As specified)	
1 Privacy Lockset	8266	Sargent	
1 Closer	4110		
2 Kick plate			

End of Section

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of the Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all glazing indicated on the drawings or specified herein.

Related Sections :

- Section 08 14 00 - Wood Doors
- Section 08 41 13 - Architectural Storefront Doors and Frames

1.03 STANDARDS

Unless specifically detailed or specified otherwise, glazing work shall be performed in accordance with the minimum standards of the Flat Glass Marketing Association (FGMA) "Glazing Manual," Latest Edition.

Glazing shall conform to the requirements of the U.S. Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials", 16 CFR 1201.

1.04 REFERENCES

- A. ASTM E774 - Sealed Insulating Glass Units.
- B. ASTM C1036 - Flat Glass.
- C. ASTM C1048 - Heat Treated Flat Glass.
- D. SIGMA - Sealed Insulated Glass Manufacturer's Association.
- E. ANSI/ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

1.05 SUBMITTALS

Samples : Submit 2 - 12'x12" samples of insulated glass unit to the Architect for approval upon request.

Product Data: For each type of product indicated. Include performance data, construction details, material descriptions and finishes.

Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum window walls, indicating compliance with performance requirements.

1.06 WARRANTY

Insulating Glass. The glass manufacturer shall warrant the insulating glass for a period of 10 years after the date of shipment from the manufacturer's plant.

Defects shall include failure of the hermetic seal, deterioration of internal glass coatings and other indications of seal failure or nonperformance, except where caused by breakage. Appearance of dirt, moisture, fogging or internal condensation at temperatures above -20 degrees F shall be considered conclusive evidence of defect.

Replacement units shall be delivered to the project site without cost to the owner.

PART 2 - PRODUCTS

2.01 GLASS

Flat glass shall conform to ASTM C1036-latest edition. Tempered and heat strengthened glass shall conform to ASTM C1048 – latest edition. Insulating glass shall be certified by the Insulating Glass Certification Council (IGCC) to level CBA in accordance with ASTM E773-Latest Edition and E-774-Latest Edition. Glass shall be as follows:

Glass: Insulating Clear Tempered Low 'e' Glass with argon gas: 1" insulating glass with organic sealed edges.

Both lites to be 1/4" thick A quality float glass, tempered.

Glass shall be tempered where required by the "Safety Standard for Architectural Glazing Materials" and at all window locations.

2.02 MANUFACTURER

Viracon Inc., Owatonna, MN or approved equal that meets or exceeds all Performance Data listed below.

Other acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Oldcastle BuildingEnvelope™.
2. Pilkington North America.
3. Vitro

Interior Glass: Viracon, Vitro or approved equal.

Exterior Glass: Viracon Inc., Owatonna, MN, or approved equal that meets or exceeds all Performance Data listed below.

Glass Type: construction: "VE1-2M"

1/4" (6mm) clear VE1-2M #2
1/2" (13.2mm) argon space
1/4" (6mm) clear

PERFORMANCE DATA

Transmittance

Visible Light	70%
Solar Energy	33%
U-V*	10%

Reflectance

Visible Light-Exterior	11%
Visible Light-Interior	12%
Solar Energy	31%

NFRC U-Value

Winter	0.25 Btu/(hr x sqft x °F)
Winter	1.42 W/(M2 x °K)
Summer	0.21 Btu/(hr x sqft x °F)
Summer	1.19 W/(M2 x °K)

European U-Value	1.2
Shading Coefficient (SC)	0.43
Relative Heat Gain	89 Btu/(hr x sqft)
Relative Heat Gain	280.76 W/M2
Solar Heat Gain Coefficient (SHGC)	0.37
LSG	1.89

2.03 GLAZING MATERIALS

Glazing materials shall be as follows:

Glazing tape: Tremco 440 TAPE.

Setting blocks shall be neoprene with a Shore A hardness of 80-90 durometer. Setting blocks shall be no less than 3" long or more than 8" long. Length shall be such that loading is 15 psi. Setting blocks shall be full width of rabbet where possible.

Spacer Blocks shall be a neoprene with a Shore A hardness of 40-50 durometer, 1" to 3" long.

2.04 UNFRAMED MIRRORS

Glass for unframed mirrors shall be ¼" thick glass conforming to Fed. Spec. DD-G-451D, Mirror Select Quality. Mirrors shall be silvered, electrocopper plated and coated with an organic protective coating in accordance with Fed. Spec. DD-M-00441B (1). Glass for mirrors shall be framed with J-bars manufactured by Andscot of Stilemark. J-bar for use at bottom and sides shall have a ¼" wide exposed face and J-bars at the top shall have a 5/8" wide exposed face. J-bars shall have a polished chrome finish. Provide a continuous J-bar around the mirror perimeter.

PART 3 - EXECUTION

3.01 WORKMANSHIP

Accurately cut glass to fit actual openings while maintaining proper clearances.

Set glass over 6 square feet in area using two setting blocks. Locate setting blocks at quarter points where possible. Where not possible, move both blocks equally towards the edges. Setting blocks shall not be closer than 1/8 the glass width or 6", whichever is greater.

Set glass using spacers to insure proper edge clearance and uniform beads of compound. Clearances shall conform to the FGMA "Glazing Manual" and the glazing material manufacturer's recommendations. Center glass in glazing rabbets.

Clean sash rabbets and stops before glazing. Prime rabbets as required by the glazing material manufacturer.

Apply glazing materials strictly according to the manufacturer's instructions.

Exterior glazing shall be watertight.

3.02 ALUMINUM FRAMES

Glaze aluminum window wall with vinyl glazing inserts furnished by the door and frame manufacturer. Glaze according to the manufacturer's instructions. Vulcanize corners of glazing gaskets to form a one piece gasket.

3.03 CLEANING

Upon completion of glazing, clean glass on both sides and leave free of traces of glazing material. The final cleaning of glass is specified under Section 01 70 00 - Execution and Closeout.

End of Section

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all Gypsum Wallboard and light gauge Steel Studs indicated on the Drawings or specified herein.

The following work is specified under other Sections:

1. Wood Stud Wall Framing: Section 06 10 00 – Rough Carpentry

1.03 STANDARDS

Gypsum drywall work shall conform to the Gypsum Association (GA) "Recommended Specifications for the Application and Finishing of Gypsum Wallboard," GA-216-2000, and Gypsum Association "Fire Resistance Design Manual", GA-600, Latest Edition, unless otherwise specified herein.

Gypsum drywall partition and ceiling systems shall be constructed strictly according to the gypsum board manufacturer's current printed specifications.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

Where a fire resistance rating is required the work shall be constructed strictly according to the rated design so that the completed work will achieve the require fire resistance rating.

ASTM C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

1.05 ENVIRONMENTAL REQUIREMENTS

Do not tape and finish gypsum board when the temperature is below 60 degrees F. for 48 hours before taping and finishing is begun. Maintain 60 degrees F. temperature during and after installation.

PART 2 - PRODUCTS

2.01 STEEL STUD AND FURRING MATERIALS

Materials for steel stud partition systems and metal furring shall be manufactured by Dietrich Industries, Gold Bond, or U.S. Gypsum. Materials shall be as follows.

Steel Studs: ASTM C645. Formed from 25 gauge or 20 gauge galvanized steel. Runners shall be the same gauge as studs. Use 20 gauge galvanized steel studs at 16" OC Max. when using water-resistant tile backer board.

Metal furring channels: 24 gauge galvanized steel, profile and size as indicated on the drawings. Use 20 gauge galvanized steel when using water-resistant gypsum backer board.

Clips, screws, and other Accessories: Use Manufacturer's standard installation accessories for the attachment of studs, tracks and furring.

2.02 GYPSUM WALLBOARD

Gypsum wallboard, accessories and related materials shall be manufactured by Georgia-Pacific, National Gypsum, Georgia Pacific or U.S. Gypsum. Materials shall be as follows:

Gypsum wallboard: ASTM C36, Type X, 5/8" thick, 48" wide with tapered edges.

Metal trim shall be as follows:

Corner bead: U.S. Gypsum DUR-A-BEAD

Casing bead: U.S. Gypsum No. 200-B

Control joints: U.S. Gypsum No. 093

Fasteners: Screws, nails, clips, ties and other fasteners shall be as recommended by the gypsum board manufacturer. Screws shall conform to ASTM C1002.

Joint Treatment System shall be a perforated tape and cement system recommended by the gypsum board manufacturer and conforming to ASTM C475-81.

Acoustical Sealant Shall be SHEETROCK ACOUSTICAL SEALANT or approved equal meeting the requirements of ASTM C557 and complying with ASTM C919.

PART 3 - EXECUTION

3.03 INSTALLATION OF GYPSUM BOARD

Use tile backer board for all walls and chases containing plumbing or walls designated to have ceramic tile.

Install gypsum board with true and even surfaces and straight, sharp corners. In general, install gypsum board on ceilings before walls. Use full length boards where possible. End joints on the same side of a wall should be staggered, and end joints on opposite sides shall not occur over the same support. Do not locate normal end joints at edge of openings. Form joints neatly. Butt boards together but do not force into place. Do not place butt ends against tapered edges. No joints shall have a gap greater than 1/4."

Stagger joints between layers of double layer construction.

Construct fire resistive (hourly rated) partitions with long dimension of gypsum board applied parallel to studs, Gypsum board for all other walls and partitions and furring may be applied either parallel or at right angles to supports.

Screw to framing. For walls with gypsum board applied vertically, space screws 8" on center along edges and 12" on center in the field. For walls with gypsum board applied horizontally, space screws 12" on center.

For fire resistive partitions and ceilings, space screws according to the rated design.

Fasten gypsum board beginning at the center and work toward the outer edges. Hold the board firmly against the supports while fastening. Locate fasteners opposite each other on adjacent ends and edges. Fasteners at edges of boards shall be located 3/8" to 1/2" from the edge.

Openings for electrical devices, piping, grilles and registers shall be accurately located and neatly made so as to closely fit the devices and be completely covered by plates and escutcheons.

Acoustical treated walls shall have all penetrations made through gypsum board sealed with acoustical sealant. All studs abutting other walls and stud tracks resting on concrete floors or ceilings shall have two continuous beads of acoustical sealant between stud/track and surface.

Install corner reinforcing at external corners, and install casing beads where gypsum board abuts other material.

Install control joints where indicated on the Drawings. Where not indicated, locate control joints in walls and partitions not over 30 feet on center. Locate control joints above door frames where possible, and construct one control joint above each jamb of the door.

Seal joints, cut edges, nail and screw head and punctures in water resistant gypsum backing board with a waterproofing sealant recommended by the gypsum board manufacturer.

3.04 JOINT TREATMENT

Tape and finish gypsum board surfaces exposed to view in the finished work to a point 6" above a suspended ceiling, and fire tape only portions of partitions occurring above suspended ceilings.

Apply materials strictly according to the manufacturer's recommendations. Fill joints with joint compound, embed perforated tape and apply a skim coat of joint compound over the tape. Apply two additional coats of joint compound allowing at least 24 hours between each coat. Fill dimples and imperfections with 3 coats. Sand each coat. Avoid abrading wallboard paper. Finished surfaces shall be uniformly smooth, true and in satisfactory condition to receive paint.

End of Section

SECTION 09 51 00 – ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all acoustical treatment ceilings indicated on the Drawings or specified herein.

The work of this Section includes, but is not limited to:

1. Providing hangers, grid and tile for all areas indicated on the drawings.
2. Providing grid around mechanical and electrical components as required.

1.03 PROJECT CONDITIONS

Do not install ceiling panels until all ceiling plenum work is completed. Do not install acoustical materials until proper temperature and humidity conditions can be maintained before, during and after installation. Interior concrete work, masonry, plastering and other wet operations shall be complete and dry. Windows and doors shall be in place and glazed, and the permanent heating and ventilating systems shall be installed and operating where necessary.

1.04 EXTRA MATERIALS

Provide 2 cartons of extra acoustical ceiling panels for each specified panel type. Do not use these extra panels to replace panels damaged or stained and needing replacement prior to final acceptance.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Ceiling tile shall be manufactured by: Armstrong, Celotex, or USG Acoustical Products.

Acoustical materials shall have an ASTM E 1264 classification of Type III, Form 1 or form 2.

2.02 LAY-IN ACOUSTICAL CEILING TILE

Type 1 ceiling board shall be **Armstrong, Optima Item #3251** Ceiling board shall have a minimum Noise Reduction Coefficient (NRC) range of .95, a Articulation Class (AC) of 190, and a minimum Light Reflectance of LR .90

Square Lay-in, or comparable product of other specified manufacturers. Provide 30 year warranty against visible sag, mold and mildew. Low VOC emissions.

2.03 CEILING SUSPENSION SYSTEM

Suspension System for TYPE 1 acoustical ceiling tile ceilings shall be Prelude 15/16" system or approved equal.

Suspension system shall be an exposed tee-grid, double web, Intermediate Duty (ASTM C635-83), electrogalvanized, cold rolled steel system with 15/16" wide, capped bottom flange. Exposed surfaces shall have a white enamel finish.

All components shall be reversible, reusable and relocatable.

Hanger Wire shall be galvanized, soft temper steel wire conforming to ASTM A641-82, Class 1.

Perimeter Trim (for cloud edge): Axiom Vector (Inverted) 6" height, finish to match grid.

PART 3 - EXECUTION

3.01 INSTALLATION

Install suspension systems and acoustical materials according to ASTM C636-76 and the manufacturer's instructions.

Cooperate with mechanical and electrical contractors in locating and spacing fixtures, diffusers and similar items located in ceiling.

Lay out pattern in accordance with reflected ceiling plans. Where not otherwise indicated, lay out in such manner that margins on opposite sides of rooms are equal and greater than 1/2 tile in width.

Suspend main runners of mechanical suspension systems with not less than 12 gauge galvanized, soft annealed steel wire. Securely attach hanger wires to structure above. Hang wires vertically with no kinks or bends.

Space hangers along main runners according to manufacturer's recommendations and reinforce suspension system as necessary to adequately support the suspension system, acoustical material,

Light fixtures, grilles, registers and other mechanical equipment to be supported by the system with a maximum allowable deflection of 1/360 of the span. Maximum hanger spacing shall be 4 feet on center.

Mechanical suspension systems shall not be supported from metal deck, electrical conduit or mechanical ducts, pipes or equipment. Where spans exceed the recommended or specified spans, furnish larger main runner channels or additional reinforcing members, hangers, stiffening or bracing as necessary to support the loads without exceeding the specified allowable deflection. No swing hangers will be permitted.

Install edge moldings at walls and vertical projections through ceiling.

Suspension system shall be installed level, true to plane, at the required elevation and pattern with finished surfaces undamaged.

Install acoustical ceiling board in suspension system strictly according to the manufacturer's recommendations. All four edges of each board shall be in firm contact with, and supported by the flanges of the steel runner sections. Check level of system during installation and maintain a level and true plane.

3.03 CLEANING

Following installation, clean dirt, finger marks and other discolored spots from the surfaces in a manner and with the materials recommended by the manufacturer. Replace dirty, discolored, damaged and improperly installed units.

End of Section

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

The conditions and requirements of Division 0 and Division 1 are hereby made a part of this Section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all resilient base and flooring indicated on the Drawings or specified herein.

Work includes:

1. Vinyl base at new gypsum board walls throughout and where indicated on Drawings.
2. Moldings / trims at flooring material transitions and throughout.

Related Section:

1. Section 09 65 19 Luxury Vinyl Tile Flooring

1.03 SUBMITTALS

Submit color samples of proposed products for selection and approval by the Architect under Section 01300 - Submittals.

1.04 ENVIRONMENTAL REQUIREMENTS

Temperature. The temperature of spaces to receive resilient base and flooring shall be held at not less than 65 degrees F. for 48 hours and materials stored in these spaces at this temperature for 24 to 48 hours before installation is begun. Maintain 65 degrees F. temperature during and after installation.

1.05 EXTRA STOCK

Provide one carton of extra vinyl base materials in an unopened carton. Do not use extra stock for replacement of tiles damaged prior to final acceptance.

1.06 WARRANTY – RUBBER BASE

Warranty Limited 5 Year Commercial Warranty

PART 2 - PRODUCTS

2.01 RESILIENT TRANSITION STRIPS

Epoxy to Concrete: Johnsonite Wheeled Transition CTA-XX-J

Acceptable manufacturers: Tarkett -Johnsonite, Armstrong, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION - TRIMS

Install trims at all locations where flooring changes to other flooring finish. At door openings, install trim directly under door in closed position. Neatly cut trim to fit between transition points and install securely to substrate.

3.02 PROTECTION

Prohibit traffic from floor area for 48 hours after installation. Protect installation from construction traffic by barricading or covering with undyed, untreated building paper until final cleaning and sealing.

3.03 CLEANING AND FINISH

Remove excess adhesive from floor, base, and wall surfaces without damage.

End of Section

SECTION 09 67 00 – FLUID APPLIED FLOORING

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment, and related services necessary to install seamless fluid-applied epoxy flooring.

Work includes:

1. Epoxy flooring and integral epoxy base.

1.03 SYSTEM DESCRIPTION

- A. System shall be nominal 3/16"-1/4" resilient epoxy surfacing with broadcast-colored chips (flakes) to form a decorative surface. Surface finish shall be a clear two component UV light resistant polyaspartic grout and two component aliphatic low odor high solids urethane sealer.

1.04 SUBMITTALS

Submit color samples of proposed products for selection and approval by the Architect under Section 01 30 00 - Submittals.

1.05 QUALITY ASSURANCE

- A. Materials used in the floor surfacing shall be the products of a single manufacturer.
- B. Installation shall be performed by an applicator with a minimum of 3 years' experience in work of similar nature and scope. Installer must be approved by the manufacturer of the floor surfacing materials. The contractor shall furnish a written statement from the manufacturer that the installer is acceptable.
- C. Installer to verify locations of all flexible joints required by the provisions of this Section and by the recommendations of the related material manufacturers.
 1. Joint locations may or may not be shown in drawings.
 2. Refer to drawings required under SUBMITTALS above.
- D. Installer to keep daily log of the date of installation, room number, type, color, and method of application of product being installed. Log must be available for inspection by the Architect upon request.
- E. Contractor to have proven experience with specified system.
- F. Portable mock-up: Prior to starting application of flooring, provide full scale portable mock-up to establish acceptable quality, durability, and appearance. Mock-up size must not be less than 4 square feet.
 1. Acceptable mock-up to be standard of quality for installed work.
 2. Unacceptable installed work to be removed and replaced until acceptable. Aesthetically unacceptable but well bonded work may be overlaid or recoated per Manufacturer's instructions if thickness clearances permit.
- G. Qualifications:

1. Installer: Must be acceptable to Architect, and Manufacturer.

1.06 PROJECT CONDITIONS

- A. Maintain the ambient room and the floor temperatures at 60 degrees Fahrenheit, or above, for a period extending from 72 hours before, during and after floor installation. Concrete to receive surfacing shall have cured for at least 5 days.
- B. Dew Point: Substrate temperature must be minimum of 5 degrees above dew point prior to, during or up to 24 hours after application of flooring system.
- C. Illumination: Apply flooring system only where a minimum of 30-footcandles exist when measured 3 feet from surface.
- D. Advise other trades of fixtures and fittings not to be installed until flooring is cured and protected.

1.07 PROTECTION

- A. Protect adjacent surfaces not scheduled to receive the flooring by masking, or by other means, to maintain these surfaces free of the flooring material.
- B. Provide adequate ventilation and fire protection at all mixing and placing operations. Prohibit smoking or use of spark or flame producing devices within 50 feet of any mixing or placing operation.
- C. Provide polyethylene or rubber gloves or protective creams for all workmen engaged in applying products containing epoxy.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered to project site in original manufacturer's sealed containers including type of material, batch numbers, date of manufacture, and pertinent labels intact and legible.
- B. Store materials in dry protected area at a temperature between 60° F to 80° F.
- C. Follow all manufacturer's specific instructions and prudent safety practices for storage and handling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Specifications and quality of design standard (basis of design) based on Torginol Polymer Flake – Dolerite F9311.
- B. System description: Two-component resilient epoxy resin surfacing broadcast with colored chips (flakes) and sealed with two-component clear UV light resistant polyaspartic and two-component clear aliphatic low odor high solids urethane.
- C. Alternative manufacturers must have as a minimum the standards set forth in this specification and must be preapproved in accordance with project requirements.

2.02 MATERIALS

- A. Prime Coat: Two component penetrating damp-proof epoxy or moisture vapor control system if required.

- B. Crack Isolation/Waterproofing Membrane: Two component flexible epoxy or urethane resin membrane.
- C. Surfacing Matrix: Two component resilient epoxy resin undercoat. Two component UV light resistant pigmented polyaspartic basecoat to receive colored plastic chips.
- D. Grout and Topcoats:
 - 1. Two component UV light resistant clear polyaspartic grout.
 - 2. Two component low odor high solids aliphatic clear urethane sealer.

2.04 MIXING

- A. Apply flooring to specified physical properties.
- B. Provide decorative finish matching approved sample. Sample to be approved by Owner and Architect.

2.05 FINISHES

- A. Color as selected by Architect or Owner from the manufacturer's standard colors.
 - 1. Torginol Polymer Flake: Dolerite F9311

PART 3 - EXECUTION

3.01 PREPARATION

- A. Obtain Architect's approval of mock-up before installing flooring; see QUALITY ASSURANCE in **PART 1**.
- B. Preparation of Surface:
 - 1. Inspect surfaces to receive flooring and verify that condition is smooth and free from conditions that will adversely affect execution, permanence, or quality of work.
 - a. Remove all projections, all debris detrimental to flooring system, and dirt, oil contaminates, grease, and surface coatings affecting bond.
 - 2. Notify Architect or Owner in writing prior to commencing work of any conditions deemed unsatisfactory for the installation; installation of flooring materials is understood as acceptance of the substrate as satisfactory.
 - 3. Concrete: The General Contractor shall be responsible for hiring an independent testing service to test for moisture content and moisture vapor emission rate; install no flooring over concrete until the concrete has been cured and is sufficiently dry to achieve permanence with flooring as determined by material manufacturer's recommended bond and moisture tests.
 - a. Effectively remove concrete laitance by steel shot blasting or other method approved by flooring manufacturer.
 - b. Concrete slab shall have an efficient puncture-resistant moisture vapor barrier 10 mils thick minimum placed directly under the concrete slab (for slab on grade). Testing must be done to verify that the moisture vapor emission rate of the slab does not exceed that as recommended by the manufacturer at time of installation of the flooring or at any future date. Moisture vapor emission and moisture content testing must conform with the requirements of ASTM F-1869-98 (Calcium Chloride Test) and ASTM F-2170-02 (Relative Humidity Probe Test). If test results show excessive levels of moisture content or vapor emission rate, apply manufacturer's recommended moisture vapor emission control material.

- c. Treat cracks in concrete using manufacturer's recommended practice. Rout out crack and fill with rigid epoxy; Reinforce crack with fiberglass cloth. Refer to section 3.02.B.

3.02 INSTALLATION

- A. Install all floor materials in strict conformance with manufacturer's instructions.
- B. Route out all cracks (larger than hairline width) and fill with Key #730 or other material approved by Manufacturer of floor materials. Reinforce crack with fiberglass cloth using the epoxy primer or the epoxy used to fill the crack.
- C. Prime entire surface with recommended epoxy primer or moisture vapor control system. Allow to cure.
- D. Apply Key #580 Flexible Epoxy Membrane (or substitute Key #400 Flexible Urethane Membrane) at recommended coverage rate and allow to cure.
- E. Apply Key #589-SL Resilient Epoxy at recommended coverage rate and allow to cure.
- F. Apply Key #470 Polyaspartic Coating (pigmented) at recommended coverage rate and broadcast colored chips (flakes) to match approved sample. Allow to cure.
- G. Apply UV light resistant polyaspartic grout Key #470 and allow to cure. Apply urethane sealer Key #467-HS and allow to cure. Topcoats shall provide a uniform, dense surface.
- H. Match finished work to approved sample, uniform in thickness, sheen, color, pattern, and texture, and free from defects detrimental to appearance.
- I. Apply temporary protection until floor is fully cured. The General Contractor shall protect the finished floor from the time that the sub-contractor completes the work.
 1. Cover flooring with kraft paper. Do not apply tape to surface of flooring.
 2. Cover kraft paper with ¼ inch (6 mm) thick hardboard, plywood, or particle board where area is exposed to foot traffic or vehicle traffic pattern, or where rolling/fixed scaffolding and overhead work occurs.

End of Section

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all painting indicated on the Drawings or specified herein.

1.03 SUBMITTALS

Samples. Submit manufacturer's standard paper chip samples, illustrating range of colors and textures available for each surface finishing project scheduled.

Submit two painted samples 8-1/2" x 11" illustrating selected colors and textures for each color and system selected with the specified coats.

Submit two stained wood samples 8-1/2 x 11" on wood specified, illustrating selected colors and textures for each color and system selected with specified finish coats.

1.04 EXTRA STOCK

Leave on the premises, where directed by the Architect, not less than one gallon of each color and type of paint used. Containers are to be clearly labeled.

PART 2 - PRODUCTS

2.01 MATERIALS

Paint materials shall be the best grade and quality products manufactured by Sherwin Williams, Benjamin Moore, PPG or approved equal.

The Contractor shall verify in writing that he intends to use the proprietary products listed in the paint schedules or submit a list of comparable materials of another listed, approved manufacturer. The submittal shall include full identifying product names and catalog numbers.

Where a particular coating formula or custom mix is specified, indicated on the Drawings or indicated in the Architect's color schedule, the material shall be purchased from the indicated manufacturer.

All base coats and finish coats on a specified surface shall be compatible products of the same manufacturer. Field applied materials shall be compatible with factory applied primers.

Shellac, linseed oil, turpentine, thinner and other miscellaneous materials shall be pure, of highest commercial quality and shall have identifying labels on containers.

2.02 COLORS

Colors will be selected by the Owner/Architect from a standard range of colors.

P1: Natural Walls
P2: HM Doors & Frames
P3: Accent Walls

Approximately 50% of the painting may be deep tones.

2.03 MIXING

Mix and thin materials strictly according to the manufacturer's instructions without adulterations. Paints shall be premixed insofar as possible. Thin only as permitted by manufacturer's label instructions and avoid unnecessary thinning.

Each coat of paint shall have a slight variation in color to distinguish it from the preceding coat. Tint primer and subsequent undercoats to approximate shade of final coat.

PART 3 - EXECUTION

3.01 PREPARATION

Protect finished surfaces, work of other trades and property of Owner from damage and defacement. Cover floors and fixed equipment with drop cloths during surface preparation, priming and finishing. Mask and suitably cover surfaces not readily covered with drop cloths.

Examine factory finished and primed surfaces to be painted and verify compatibility of existing paint with materials to be applied. Report incompatible or unsuitable materials immediately to the Contractor and the Architect in writing.

Surfaces to be painted shall be thoroughly dry, smooth and even, clean, free of dust and properly prepared to receive the intended finish.

Touch up primer coats of factory primed materials to be painted.

Ferrous metal shall be thoroughly cleaned to remove rust, mill scale, grease and dirt. Clean rusted, chipped and abraded areas in shop coats, and touch up with primer before applying specified field coats. Sand, scrape and wire brush unprimed ferrous metal and prime immediately.

Prime ferrous metal surfaces which could come into contact with PVA and other latex paints and primers and allow to dry before the latex primer or paint is applied.

Unprimed galvanized metal shall be thoroughly cleaned and wiped with xylol, tolluol or other aromatic solvent before priming. Clean and touch up chipped and abraded areas in shop coats with primer before applying specified field coats.

Aluminum shall be thoroughly cleaned of foreign matter before priming.

Wood to be stained and finished or clear finished shall be thoroughly hand sanded to remove dirt and stains and produce smooth surfaces suitable to receive intended finish. Thoroughly remove dust. Back-prime interior

millwork and trim with a sealer compatible with the specified finish. Fill voids and nail holes with a pigmented filler compatible with the specified finish after the first coat is dry.

Fill minor irregularities in gypsum board with spackle. Sand smooth, even with surface when dry. Avoid raising nap of paper. Remove dust.

Concrete block and plaster walls shall be free of loose particles, dirt and stains, and shall be thoroughly cured and dry.

Concrete floors shall be thoroughly cleaned of foreign matter and grease before painting.

NEW, UNCOATED CONCRETE: Remove oil, dirt, grease and other chemical contaminants by cleaning with 3599 Industrial Pure Strength® Cleaner/Degreaser, detergent, or other suitable cleaner. Rinse with water. Etch concrete with 108 Cleaning & Etching Solution. Rinse thoroughly and immediately, and allow to dry. After acid etching the concrete should have a surface profile that resembles fine grit sandpaper. If not, repeat the process.

New concrete should be allowed to cure for 30 days before application of any coating. If there is any doubt about the dryness of the concrete, conduct a test by simply placing a weighted rubber mat, plastic sheet or other non-porous material on the surface for 24 hours. Check the underside of the mat and concrete for signs of moisture. The substrate will be darker if damp. If moisture is found, allow additional drying time (10-14 days) and repeat test.

If moisture persists concrete surface cannot be coated. Very dense, non-porous or chemically treated concrete may require shotblasting to assure proper coating adhesion. Determine porosity by pouring one ounce of water onto the concrete. If water soaks in, the surface is porous enough for coating. If water beads up on the concrete, the surface is not porous and treatment is warranted. The presence of laitance (fine white particles) will also require shot blasting or abrading to assure removal.

PREVIOUSLY COATED: Remove loose dirt, dust and previous coating by sweeping or vacuum concrete cleaning. Remove grease, oil, floor compound or wax as indicated above under **new, uncoated concrete**. Very glossy or hard coatings should be lightly sanded to insure maximum adhesion. The floor system will not lift most previous coatings. Concrete floor areas which require patching should be free of dirt, oil, grease and other chemical contaminants as indicated above under **new, uncoated concrete**. Loose concrete and deteriorated previous paint must be removed. The 5499 Concrete Patching Compound can then be trowel applied and allowed to cure four hours before applying a coating.

3.02 APPLICATION

Apply materials strictly according to the manufacturer's instructions. Each coat shall be applied at a rate not to exceed that recommended by the manufacturer for the type of surface and shall have a dry film thickness not less than that recommended. Paint materials shall be evenly spread, and smoothly flowed on to avoid runs, sags, holidays, and brush marks, air bubbles, and excessive roller stipple. Achieve uniformity in final texture and dry thickness.

Coverage and hide shall be complete. When the color of undercoats shows through the top coat, the surface shall be re-painted with additional coats until the paint film is consistent in color, texture, and thickness. All coats shall be thoroughly dry before applying succeeding coats.

Apply stain uniformly and wipe off if required. Wipe paste filler for open grain wood across the grain to fill the pores and then with the grain to produce a smooth, clean surface.

Allow each coat to dry thoroughly before sanding or applying subsequent coats. Lightly sand each coat of varnish and enamel applied to wood or metal with fine sandpaper and wipe clean with a tack rag before the next coat is applied. Avoid cutting through paint at edges.

Before applying second coat to plaster and concrete, touch up hot spots and allow to dry.

Concrete Floors : Apply only when air and surface temperatures are between 60-100°F (15-38°C), surface is at least 5°F above the dew point and relative humidity is below 85% during and after application. Apply by roller using a good quality 1/4" synthetic nap cover. On new or uncoated concrete, two coats of product should be applied. The first coat should be thinned 20% with water to assure penetration into the concrete surface. The first coat may be spread out using a rubber squeegee, then back roll to smooth out the finish.

Apply the second coat by roller. Recoat previously coated floors by roller only. This coating can tolerate application to damp surfaces; however, conditions must be favorable to allow the moisture to evaporate. Applications done at low humidity conditions (less than 15%) may result in lower initial gloss; however, this will not negatively affect performance. Allow coated floor to cure 7 days before mopping or washing. Use 200 Anti-Skid Floor Coating Additive for skid resistance where oil or water spillage is a problem.

For touch-up prior to final acceptance, use the same application method to apply paint as the original, underlying work. For example, if the prior application of wall paint was with a roller, apply touch-up paint with the same type of roller to achieve a consistent finish.

3.03 PAINTING SCHEDULE

The following schedule is a general outline of the work included and is not intended to be a complete, detailed tabulation.

The number of coats listed herein are field applied coats, and all coats will be required even though surfaces have been factory primed. A factory applied one-coat combination primer-finish shall be considered a prime coat only.

Sherwin Williams is generally used herein as a standard of quality, and equivalent products of other specified manufacturers may be used interchangeably, unless specifically prohibited.

A. Exterior

1. Exterior ungalvanized ferrous metal, including hollow metal doors and frames and miscellaneous metal work shall have:

1 Coat	KEM KROMIK Metal Primer
2 coats	Industrial Enamel - High Solids

2. Exterior galvanized metal, including galvanized sheet metal shall have:

1 coat	GALVITE Paint
2 coats	Industrial Enamel - High Solids

3. Exterior aluminum shall have:

1 coat	DTM Wash Primer
1 coat	Industrial Enamel - High Solids

4. Exterior Concrete Masonry Unit shall have:

1 coat CMU Sealer

B. Interior

1. Interior ungalvanized ferrous metal shall have:

1 Coat KEM KROMIK Metal Primer
2 coats PROMAR 200 Alkyd semi-gloss enamel

2. Interior ungalvanized steel spec FD primed ferrous metal shall have :

1 coat KEM BOND HS (if unprimed)
2 coats WATERBORNE ACRYLIC DRY FALL with Clear Tint
Base (Flat)

3. Interior galvanized metal in finished spaces shall have:

1 coat Galvite Paint (if unprimed)
2 coats PROMAR 200 Alkyd semi-gloss enamel

4. Interior gypsum board to be painted shall have:

1 coat PROMAR 200 Latex Wall Primer
2 coats PROMAR 200 Latex egg-shell enamel

C. Mechanical and Electrical Work

Paint exposed unfinished surfaces of mechanical and electrical materials and equipment occurring in finished spaces or adjacent to finished surfaces, including grilles, registers, piping, convectors, radiation, ducts, piping and duct insulation, conduit, panels and cabinets.

Paint exposed unfinished surfaces of mechanical and electrical materials and equipment such as roof top units, piping, conduit or other items occurring on the exterior of the building where exposed to view.

Mechanical and electrical items to be painted shall be painted as specified above for the exposure (interior or exterior) and the respective type of material. Small items such as grilles and registers occurring in painted walls and ceilings shall have the same type of finish (flat or satin) as the wall or ceiling, and all other items shall have a satin finish.

End of Section

SECTION 10 14 23 – PANEL SIGNAGE

PART 1 - GENERAL

1.01 CONDITIONS OF THE CONTRACT

Drawings and general provision of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections, apply to work of this section.

1.02 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all signage as indicated on the Drawings or specified herein.

1.03 SUBMITTALS

Shop Drawings. Submit shop drawings for approval.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS ROOM IDENTIFICATION SIGNS

Room identification signage shall be manufactured by SPECTRUM SIGN SYSTEMS, ASI SIGN SYSTEMS, SERIGRAPHICS SIGN SYSTEM, ANDCO INDUSTRIES, or ADVANCE CORPORATION.

Room Identification Signs: ASI Intouch or comparable system of other approved manufacturers.

Interior signs shall match existing, interior, building signage. Letters shall be 1" high, white, Sans Serif capital letters projecting from the adjacent surfaces a minimum of 1/32". Provide permanent mounting. Signs shall meet the requirements of the Americans With Disabilities Act ADA 1992 and the Minnesota Accessibility Code. Provide both text and room number as indicated below. Provide a 1" high horizontal slot within sign for temporary sign (Name). Provide Braille, as required by Code.

The following is a list of signs:

Quantity	Text	Location on Drawing (Room Number) *
1	TRAINING ROOM	102
2	UNISEX RESTROOM	103, 104
2	OFFICE	106, 107

*Actual numbers to be used on signs will be reviewed and approved by Owner.

Interior wall signs shall be installed with foam mounting tape.

PART 3 - EXECUTION

3.01 INSTALLATION

Install signs after wall surfaces are painted and finished, in locations directed by Architect, and as required by the Americans with Disabilities Act and 2020 Minnesota State Accessibility Code.

Install centered and level, in line, in accordance with the manufacturer's instructions.

End of Section

SECTION 10 26 00 – WALL PROTECTION

PART 1 – GENERAL

1.1 CONDITIONS OF THE CONTRACT

The conditions and requirements of Division 0 and Division 1 are hereby made a part of this Section.

1.2 SECTION INCLUDES

- A. Wall protection panels.
- B. Mounting hardware, adhesive, sealants, accessories, and trim.

1.3 RELATED SECTIONS

- A. Section 09 29 00 - Gypsum Board

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Show locations of each item and installation details. Provide elevations of non-standard conditions.
- C. Selection Samples: Color charts consisting of actual product pieces, demonstrating full range of available colors, for initial color selection.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site in unopened packages which clearly state the manufacturer and location of fabrication.
- B. Store products in unopened packaging, on flat, fully supportive surfaces in a space conditioned to maintain a minimum temperature of 40 degrees F. and a maximum temperature of 100-degrees F.

1.6 PROJECT CONDITIONS

- A. Materials shall be acclimated to between 65-degrees F. and 75 degrees F. for a minimum of 24-hours prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Wall protection surfaces: C/S Acrovyn wall protection sheets, .060 (1.56 mm) thick.
Color: Blue Silk, #930, suede texture.
- B. Manufacturers of equivalent products submitted and approved in accordance with product substitution procedures.

2.2 DESCRIPTION

- A. Wall protection shall be C/S Acrovyn, PVC-free materials, 4000 with shadow-grain texture, .060" thick (1.52 mm) and shall include the installation of all available trims.

2.3 DESIGN AND PERFORMANCE CRITERIA

A. Flammability Characteristics:

1. Class A Interior wall finish (NFPA 101 Life Safety) when tested in accordance with ASTM E84.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 450 or less
2. Classification of HB when tested in accordance with ASTM D635.

B. Stain Resistance: High impact vinyl components.

1. Material to be tested for stain resistance to various chemical reagents in accordance with ASTM D543.

C. Bacterial and Fungal Growth:

1. Material must not support bacteria or fungal growth when tested in accordance with ASTM G21 and ASTM G22.

D. Impact Resistance:

1. Extruded profiles shall resist damage from impact at apex of 90° corner when tested in accordance with applicable sections of ASTM F476.
2. Izod impact strength ASTM D256 method A notched, 23.8 ft-lbs./in average with no break.
3. Charpy impact strength ASTM D6110 notched, 26.1 ft-lbs./in average with no break.

2.4 ACCESSORIES

- B. Provide appropriate fasteners and accessories as required to properly complete wall panel installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that walls are in proper condition to receive installation of wall protection panels.

1. Surface mounted wall protection panels must be installed after wall finishes have been completed.

3.2 INSTALLATION

- A. Install wall panels in full compliance with manufacturer's installation instructions using mastic cement. Install trim.
- B. Apply mastic cement (by others) generously to back of wall panels and press firmly to wall surface. Remove excess mastic cement from around edge of wall panel and allow to dry for 24 hours.

3.3 VERIFICATION AND CLEANING

- A. Verify that wall panels are plumb and rigidly secured to substrate.
- B. Clean wall panels and immediate areas of installation, using materials and methods recommended by manufacturer. Remove from project site packaging and debris caused by installation.

END OF SECTION

SECTION 10 28 00 - TOILET SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all toilet, bath, and washroom accessories as indicated on the Drawings or specified herein.

1.02 REFERENCES

ASTM A123 - Zinc (Hot-dip Galvanized) coatings on iron and steel products.
ASTM A167 - Stainless and Heat-resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A269 - Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
ANSI A117.1 - Safety Standards for the Handicapped.

1.03 SUBMITTALS

Shop Drawings. Submit shop drawings and Product Data for approval (see Section 01 30 00 - Submittals.)

1.04 REGULATORY REQUIREMENTS

Furnish and install products in accordance with ANSI 117.1 and 2020 Minnesota Accessibility Code requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Accessories shall be manufactured by BOBRICK, AMERICAN SPECIALTIES, BRADLEY, TUBULAR SPECIALTIES, GAMCO.

2.02 MATERIALS

Sheet steel: ASTM A366

Stainless Steel Sheet: ASTM A167, Type 304; minimum 22 gauge.

Tubing: ASTM A269, stainless steel, commercial grade, seamless.

Adhesive: Two component epoxy type.

Fasteners, Screws, and Bolts: Hot dip galvanized, [tamper proof] [and] [security type].

Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FABRICATION

Weld and grind joints of fabricated components smooth.

Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 1-1/2 inches clear of wall surface. [Knurl grip surfaces]

Shop assemble components and package complete with anchors and fittings.

Provide steel anchor plates, adapters, and anchor components for installation.

2.04 KEYING

Supply five (5) keys for each accessory to Owner.

Key all accessories.

2.05 FINISHES

Stainless Steel: No. 4 satin luster.

Shop Primed Ferrous Metals: Pretreat and clean. Spray-apply one coat primer and bake.

Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats electrostatic baked enamel.

Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 - EXECUTION

3.01 EXAMINATION

Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.

Verify with Architect/Engineer exact location of accessories for installation.

3.02 PREPARATION

Deliver inserts and rough-in frames to site for timely installation.

Provide templates and rough-in measurements as required.

3.03 INSTALLATION

Install accessories in accordance with manufacturer's instructions and ANSI A117.1.

Install plumb and level, securely and rigidly anchored to substrate.

Use tamper-proof fasteners.

3.04 SCHEDULE OF ACCESSORIES

All numbers are Bobrick, unless noted otherwise.

Room 103 New Restroom:

- Toilet Paper Dispenser: B-2740
- Paper Towel dispenser: B-72974
- Liquid Soap Dispenser B-2111
- Grab Bars: B-6806.99
- Sanitary Napkin Disposal: B-254
- Mirror: B-2908 1836

Room 104 Existing Restroom:

- Toilet Paper Dispenser: B-2740
- Paper Towel dispenser: B-72974
- Liquid Soap Dispenser B-2111
- Grab Bars: B-6806.99
- Mirror: B-2908 1836

End of Section

SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.01 SUMMARY

This Section includes all labor, material, equipment and related services necessary to furnish and install all metal lockers, accessories, mounting platforms, touch-up, and trim indicated on the Drawings or specified herein.

The work of this section includes:

1. Installation of concrete locker bases, as required.
2. Wood furring, blocking or trim required for the locker installation or as indicated on the drawings.
3. Installation of tile base attached to the locker base, if required.
4. Final clean-up.

Related work shown in other Sections :

1. Wood Blocking and furring - Section 06 10 00
2. Construction Waste Management – Section 01 70 00

1.02 SUBMITTALS

Shop Drawings. Submit shop drawings and product data for approval (see Section 01 30 00, Submittals.) Show locker quantities, sizes, types and include all installation details. Provide a color chart if color not specified.

1.03 QUALITY ASSURANCE

Concrete work: Bases formed of concrete shall be constructed by experienced concrete finishers.

Non-locker related work: Touch-up painting, installation of base or other non-locker related work shall be done by skilled tradesman operating in their area of expertise.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

All lockers shall be purchased from a single manufacturer.

Corridor Metal lockers shall be manufactured by:

Art Metal Inc. – ALL-WELDED
Debourgh Manufacturing: CORRIDOR LOCKERS
Lyon INTEGRATED FRAME ALL-WELDED LOCKERS
Penco – PRO-TOUGH
Republic LLC – STANDARD CORRIDOR LOCKERS

2.02 MATERIALS

Corridor Lockers

Basic Construction: All lockers shall be pre-assembled of welded construction.

Frame: Manufacturer's standard steel frame.

Door: 16 gauge steel with manufacturer's standard louvers, top and bottom. Lock bar shall be fully concealed with a steel shape.

Side panels: 16 gauge cold-rolled steel. Use non-perforated at row end panels.

Top and bottom panels: 16 gauge cold-rolled steel.

Back panels: 18 gauge cold-rolled steel.

RYDER SYSTEM, INC
Eagan, Minnesota

Hat shelf: 16 gauge cold-rolled steel with returned flange on the front side. Provide a hat shelf for all lockers over 42" high.

Door hinges: Manufacturer's standard of either a continuous piano hinge or Manufacturer' standard 5-knuckle hinges.

Latching: For lockers over 42" high provide a 3-point latching system. For lockers 42" and under, provide a 2-point latching system. Latch shall consist of manufacturer's standard steel bar contained in the door channel and encased in self-lubricating polyethylene guides that isolate the steel bar and prevent metal to metal contact.

Handle: Recessed, 20 gauge stainless steel pocket with a finger lift and designed to accept a standard combination lock.

Coat hooks: Steel with ball points, zinc-plated and attached with rivets.

One single hook on each side and one on the rear panel.

One double hook mounted from the shelf center.

Finish: Paint all surfaces with manufacturer's standard painting system, either a baked enamel system or polyester resin powder coat system. Color shall be selected from manufacturer's complete palette of standard colors.

Numbering system: Provide manufacturer's standard clear aluminum numbering plate with black numbers printed onto the plate. Attach plates with rivets. Begin numbering system on First Floor with "1" and consecutively number the lockers from beginning to end.

Lock : Padlock provided by employee.

2.04 CONCRETE MATERIALS

Use Type 1 Portland cement, 3,000 psi concrete with a slump between 3 and 4 inches. Pour concrete into wood forms matching all dimensions of the concrete base.

PART 3 – EXECUTION

3.01 NOT USED

3.02 INSTALLATION

Install concrete bases. Clean sealers off concrete floor prior to installation to ensure good adhesions between existing concrete floors and new concrete. Embed wood nailers and furring strips, as required.

Assemble and install all lockers according to the approved plans. Install lockers in a substantial fashion with concealed or tamper-proof fasteners.

Install lockers plumb, true, in alignment with each other, and securely fastened to the base, walls, and each other as required by manufacturer not to exceed fastening at 4'-0" on center. Install flashings, fillers, bases, and trims as needed for a complete project.

Adjust lockers, door swings, locking mechanisms, and locker operation so that operation is smooth, consistent, with no grating components.

Touch-up all scratches and scrapes with manufacturer's matching touch-up paint.

3.03 CLEAN-UP

Wash and clean all locker components. Remove all materials, trash, and debris from the project site. Touch up paint any walls where locker installation caused damage to the walls.

End of Section

SECTION 10 73 13 – PROTECTIVE COVERS - AWNINGS

PART 1 – GENERAL

1.1 CONDITIONS OF THE CONTRACT

The conditions and requirements of Division 0 and Division 1 are hereby made a part of this Section.

1.2 SECTION INCLUDES

- A. Protective covers – metal canopies.
- B. Mounting hardware, accessories, and trim.

1.3 RELATED SECTIONS

- A. Section 02 41 00 – Selective Demolition

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Show locations of each item and installation details for corresponding product.

1.5 QUALITY ASSURANCE

- A. Complies with ASCE 7-10, allowable stress design

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site in unopened packages which clearly state the manufacturer and location of fabrication.
- B. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice".
- C. Materials and installation area shall be protected from the elements. Ensure installation area is free of excess moisture and debris.

1.7 PROJECT CONDITIONS

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Metal canopy shall be supplied by FLS Canopy or approved equal.

2.2 DESCRIPTION

- A. Canopy design shall be single gable bolted frame.
- B. Canopy shall extend out from building steel line 42". Building steel line is defined as the will girt's outside edge.
- C. Canopy roof slope shall be 1:12.
- D. 3/8" 16 UNC Grade 5, NC, plated hex head cap screws with nuts shall be used in the following connections: clip angles to existing building structural framing, vertical frame support channels, vertical frame support channel to horizontal support channel, center plates to framing channels.

- E. Other framing connections shall be 1/4" 20 UNC grade 8, NC, plated hex head cap screws with nuts.
- F. All material shall be new and free from defects.

2.3 DESIGN AND PERFORMANCE CRITERIA

- A. Canopy size to be 5' x 42". Gabled.
- B. Frame to be constructed according to parameters herein:

Horizontal Channel: 5 1/2" x 1 3/4" x 14GA galvanized steel channel
Gable Channel: 4" x 1 1/2" x 16GA galvanized steel channel
Connection Plates: (2) 12GA galvanized steel plates
Vertical Channel: 5 1/2" x 1 3/4" x 14GA galvanized steel plates
Connection Clip-gable Channel: 1 3/4" x 3 3/4" x 3 1/2" x 14GA galvanized steel angle
Hat purlin: 20GA galvanized steel hat channel
Connection Bracket: 5 3/4" channel bracket 1 3/4" wide 10GA galvanized steel
Large Connection Bracket: 5 3/4" channel bracket 3 1/2" wide 10GA galvanized steel
Reinforcing Clip: 2 1/4" x 2 1/4" x 1 3/4" 10GA galvanized steel
Large Reinforcing Clip: 2 1/4" x 2 1/4" x 3 1/2" 10GA galvanized steel

- C. Cover to be constructed according to parameters herein:

Roof Sheet: 26GA 50,000 PSI minimum yield steel (ASTM A446-72 Grade D) with G-90 Zinc Coating (ASTM Galvanized Specification A525) or Aluminum-Zinc Alloy coating (ASTM Specification A792) Kynar 500/Hylar 5000 Fluoropon factory colored
Transition Flashing: 26GA 50,000 PSI minimum yield steel Kynar 500/Hylar 5000 Fluoropon factory colored
Rake Trim: 26GA 50,000 PSI minimum yield steel Kynar 500/Hylar 5000 Fluoropon factory colored
Soffit Panels: White basket weave vented, 100% vinyl, lifetime limited warranty from Georgia Pacific
Eave Trim: 26GA 50,000 PSI minimum yield steel Kynar 500/Hylar 5000 Fluoropon factory colored
Foam Inside Closure: Match configuration of roof panel to provide a weather tight seal at the top of sided trim
Eave Filler: 26GA 50,000 PSI minimum yield steel Kynar 500/Hylar 5000 Fluoropon factory colored
Peak Plate: 26GA 50,000 PSI minimum yield steel Kynar 500/Hylar 5000 Fluoropon factory colored

2.4 ACCESSORIES

- D. Provide appropriate fasteners and accessories as required to properly complete canopy assembly installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that exterior walls are in proper condition to receive installation of wall canopy assembly.

3.2 INSTALLATION

- A. Install canopy in full compliance with manufacturer's installation instructions using materials noted.

3.3 VERIFICATION AND CLEANING

- A. Verify that canopy elements are plumb and rigidly secured to structure.

END OF SECTION

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END OF SECTION

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Floor plates.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Supports and anchorages.
- C. Related Sections:
 - 1. Division 01 Section "Project Management and Coordination" for requirements related to each subcontractor's responsibility to complete coordination drawings and submit.
 - 2. Division 01 Section "Closeout Submittals" for requirements related to each subcontractor's responsibility to submit record drawing to the owner as part of the operation and maintenance data.
 - 3. Division 23 Section "Common Work Results for HVAC", 1.5 Coordination.

1.2 DEFINITIONS

- A. Refer to General Conditions for additional definitions.
- B. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic Carbon steel Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

2.7 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for

joint sealants in Division 07 Section

- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- C. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.

6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 FLOOR PLATE INSTALLATION

- A. Install floor plates for piping penetrations of equipment-room floors.
- B. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 1. New Piping: One-piece, floor-plate type.

3.12 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 22 0519 - METERS AND GAGES FOR PLUMBING PIPING**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.

1.2 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data

PART 2 PRODUCTS**2.1 BIMETALLIC-ACTUATED THERMOMETERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - 1. Ernst Flow Industries.
 - 2. Ashcroft Inc
 - 3. Marsh Bellofram.
 - 4. Miljoco Corporation.
 - 5. Nanmac Corporation.
 - 6. Noshok.
 - 7. Palmer Wahl Instrumentation Group.
 - 8. REOTEMP Instrument Corporation.
 - 9. Tel-Tru Manufacturing Company.
 - 10. Terrice, H. O. Co.
 - 11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 12. Weiss Instruments, Inc.
 - 13. WIKA Instrument Corporation - USA.
 - 14. Winters Instruments - U.S.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.

- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - h. Insert manufacturer's name.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed Open-front, pressure relief Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal Brass Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid one-third of pipe diameter to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water boiler.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
- I. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Suction and discharge of each domestic water pump.
- J. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- K. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, Sealed bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 200 deg F.

3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Iron, single-flange butterfly valves.
 - 4. Bronze swing check valves.
 - 5. Iron swing check valves.
 - 6. Iron swing check valves with closure control.
 - 7. Bronze gate valves.
 - 8. Iron gate valves.
- C. Related Sections:
 - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS**1.3 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.

1.4 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. 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.
 - 3. Butterfly Valves: With extended neck.
- F. 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.

1.5 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Hammond Valve.
 4. Kitz Corporation.
 5. Milwaukee Valve Company.
 6. NIBCO INC.
 7. Description:
 - a. Standard: MSS SP-110.
 8. SWP Rating: 150 psig.
 9. CWP Rating: 600 psig.
 10. Body Design: Two piece.
 11. Body Material: Forged brass.
 12. Ends: Threaded.
 13. Seats: PTFE or TFE.
 14. Stem: Brass.
 15. Ball: Chrome-plated brass.
 16. Port: Full.

1.6 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 2. Conbraco Industries, Inc.; Apollo Valves.
 3. Crane Co.; Crane Valve Group; Crane Valves.
 4. Hammond Valve.
 5. Milwaukee Valve Company.
 6. NIBCO INC.
 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 8. Description:
 - a. Standard: MSS SP-110.
 9. SWP Rating: 150 psig.
 10. CWP Rating: 600 psig.
 11. Body Design: Two piece.
 12. Body Material: Bronze.
 13. Ends: Threaded.
 14. Seats: PTFE or TFE.
 15. Stem: Bronze.
 16. Ball: Chrome-plated brass.
 17. Port: Full.

1.7 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 2. Conbraco Industries, Inc.; Apollo Valves.
 3. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 4. Crane Co.; Crane Valve Group; Jenkins Valves.
 5. Crane Co.; Crane Valve Group; Stockham Division.
 6. DeZurik Water Controls.
 7. Flo Fab Inc.
 8. Hammond Valve.
 9. Kitz Corporation.
 10. Milwaukee Valve Company.
 11. NIBCO INC.
 12. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 13. Description:
 - a. Standard: MSS SP-67, Type I.
 14. CWP Rating: 200 psig.
 15. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 16. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 17. Seat: EPDM.
 18. Stem: One- or two-piece stainless steel.
 19. Disc: Aluminum bronze.
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 2. Conbraco Industries, Inc.; Apollo Valves.
 3. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 4. Crane Co.; Crane Valve Group; Jenkins Valves.
 5. Crane Co.; Crane Valve Group; Stockham Division.
 6. DeZurik Water Controls.
 7. Flo Fab Inc.
 8. Hammond Valve.
 9. Kitz Corporation.
 10. Milwaukee Valve Company.
 11. NIBCO INC.
 12. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 13. Description:
 - a. Standard: MSS SP-67, Type I.
 14. CWP Rating: 200 psig.
 15. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 16. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 17. Seat: NBR.

18. Stem: One- or two-piece stainless steel.
 19. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 2. American Valve, Inc.
 3. Conbraco Industries, Inc.; Apollo Valves.
 4. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 5. Crane Co.; Crane Valve Group; Center Line.
 6. Crane Co.; Crane Valve Group; Stockham Division.
 7. DeZurik Water Controls.
 8. Flo Fab Inc.
 9. Hammond Valve.
 10. Kitz Corporation.
 11. Milwaukee Valve Company.
 12. Mueller Steam Specialty; a division of SPX Corporation.
 13. NIBCO INC.
 14. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 15. Description:
 - a. Standard: MSS SP-67, Type I.
 16. CWP Rating: 200 psig.
 17. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 18. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 19. Seat: EPDM.
 20. Stem: One- or two-piece stainless steel.
 21. Disc: Nickel-plated or -coated ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
1. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 2. American Valve, Inc.
 3. Conbraco Industries, Inc.; Apollo Valves.
 4. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 5. Crane Co.; Crane Valve Group; Center Line.
 6. Crane Co.; Crane Valve Group; Stockham Division.
 7. DeZurik Water Controls.
 8. Flo Fab Inc.
 9. Hammond Valve.
 10. Kitz Corporation.
 11. Milwaukee Valve Company.
 12. Mueller Steam Specialty; a division of SPX Corporation.
 13. NIBCO INC.
 14. Spence Strainers International; a division of CIRCOR International, Inc.
 15. Sure Flow Equipment Inc.
 16. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 17. Description:
 - a. Standard: MSS SP-67, Type I.
 18. CWP Rating: 200 psig.

19. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
20. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
21. Seat: NBR.
22. Stem: One- or two-piece stainless steel.
23. Disc: Nickel-plated or -coated ductile iron.

1.8 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 2. Crane Co.; Crane Valve Group; Crane Valves.
 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 4. Crane Co.; Crane Valve Group; Stockham Division.
 5. Hammond Valve.
 6. Kitz Corporation.
 7. Milwaukee Valve Company.
 8. NIBCO INC.
 9. Powell Valves.
 10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 11. Description:
 - a. Standard: MSS SP-80, Type 3.
 12. CWP Rating: 200 psig.
 13. Body Design: Horizontal flow.
 14. Body Material: ASTM B 62, bronze.
 15. Ends: Threaded.
 16. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Hammond Valve.
 5. Kitz Corporation.
 6. Milwaukee Valve Company.
 7. NIBCO INC.
 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 9. Description:
 - a. Standard: MSS SP-80, Type 4.
 10. CWP Rating: 200 psig.
 11. Body Design: Horizontal flow.
 12. Body Material: ASTM B 62, bronze.
 13. Ends: Threaded.
 14. Disc: PTFE or TFE.

1.9 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Hammond Valve.
 5. Kitz Corporation.
 6. Milwaukee Valve Company.
 7. NIBCO INC.
 8. Powell Valves.
 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 10. Description:
 - a. Standard: MSS SP-71, Type I.
 11. CWP Rating: 200 psig.
 12. Body Design: Clear or full waterway.
 13. Body Material: ASTM A 126, gray iron with bolted bonnet.
 14. Ends: Flanged.
 15. Trim: Bronze.
 16. Gasket: Asbestos free.
- B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Stockham Division.
 3. Description:
 - a. Standard: MSS SP-71, Type I.
 4. CWP Rating: 200 psig.
 5. Body Design: Clear or full waterway.
 6. Body Material: ASTM A 126, gray iron with bolted bonnet.
 7. Ends: Flanged.
 8. Trim: Composition.
 9. Seat Ring: Bronze.
 10. Disc Holder: Bronze.
 11. Disc: PTFE or TFE.
 12. Gasket: Asbestos free.

1.10 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 3. CWP Rating: 200 psig.
 4. Body Design: Clear or full waterway.
 5. Body Material: ASTM A 126, gray iron with bolted bonnet.

6. Ends: Flanged.
 7. Trim: Bronze.
 8. Gasket: Asbestos free.
 9. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Hammond Valve.
 5. Milwaukee Valve Company.
 6. NIBCO INC.
 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 8. Description:
 - a. Standard: MSS SP-71, Type I.
 9. CWP Rating: 200 psig.
 10. Body Design: Clear or full waterway.
 11. Body Material: ASTM A 126, gray iron with bolted bonnet.
 12. Ends: Flanged.
 13. Trim: Bronze.
 14. Gasket: Asbestos free.
 15. Closure Control: Factory-installed, exterior lever and weight.

1.11 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 2. Crane Co.; Crane Valve Group; Crane Valves.
 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 4. Crane Co.; Crane Valve Group; Stockham Division.
 5. Hammond Valve.
 6. Kitz Corporation.
 7. Milwaukee Valve Company.
 8. NIBCO INC.
 9. Powell Valves.
 10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 11. Description:
 - a. Standard: MSS SP-80, Type 1.
 12. CWP Rating: 200 psig.
 13. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 14. Ends: Threaded or solder joint.
 15. Stem: Bronze.
 16. Disc: Solid wedge; bronze.
 17. Packing: Asbestos free.
 18. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
2. Crane Co.; Crane Valve Group; Crane Valves.
3. Crane Co.; Crane Valve Group; Jenkins Valves.
4. Crane Co.; Crane Valve Group; Stockham Division.
5. Hammond Valve.
6. Kitz Corporation.
7. Milwaukee Valve Company.
8. NIBCO INC.
9. Powell Valves.
10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
11. Zy-Tech Global Industries, Inc.
12. Description:
 - a. Standard: MSS SP-80, Type 2.
13. CWP Rating: 200 psig.
14. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
15. Ends: Threaded or solder joint.
16. Stem: Bronze.
17. Disc: Solid wedge; bronze.
18. Packing: Asbestos free.
19. Handwheel: Malleable iron, bronze, or aluminum.

1.12 IRON GATE VALVES

- A. Class 125, NRS, Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Flo Fab Inc.
 5. Hammond Valve.
 6. Kitz Corporation.
 7. Milwaukee Valve Company.
 8. NIBCO INC.
 9. Powell Valves.
 10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 11. Description:
 - a. Standard: MSS SP-70, Type I.
 12. CWP Rating: 200 psig.
 13. Body Material: ASTM A 126, gray iron with bolted bonnet.
 14. Ends: Flanged.
 15. Trim: Bronze.
 16. Disc: Solid wedge.
 17. Packing and Gasket: Asbestos free.
- B. Class 125, OS&Y, Iron Gate Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
2. Crane Co.; Crane Valve Group; Jenkins Valves.
3. Crane Co.; Crane Valve Group; Stockham Division.
4. Flo Fab Inc.
5. Hammond Valve.
6. Kitz Corporation.
7. Milwaukee Valve Company.
8. NIBCO INC.
9. Powell Valves.
10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
11. Description:
 - a. Standard: MSS SP-70, Type I.
12. CWP Rating: 200 psig.
13. Body Material: ASTM A 126, gray iron with bolted bonnet.
14. Ends: Flanged.
15. Trim: Bronze.
16. Disc: Solid wedge.
17. Packing and Gasket: Asbestos free.

1.13 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.

1.14 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.

1.15 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball, butterfly valves.
 2. Throttling Service: ball, or butterfly valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

1.16 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, bronze or brass with bronze or brass trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.
 4. Bronze Gate Valves: Class 125, NRS RS.

1.17 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze and brass : May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, bronze with bonze and brass trim.
 3. Bronze Swing Check Valves: bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 2. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.

END OF SECTION

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe positioning systems.
 - 6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Plumbing piping material and installation shall be per code.

PART 2 PRODUCTS**2.1 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Coatings, where designated:
 - a. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - b. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.

PART 2 PRODUCTS**2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 EXECUTION**3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - a. Radon vent piping reduce intervals to 10 feet.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule to be as follows or industry standard:
 - 1. Domestic Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: White.
 - b. Letter Color: Black.
 - 3. Propane Gas Piping
 - a. Background Color: white
 - b. Letter Color: green

END OF SECTION

SECTION 22 0700 - PLUMBING INSULATION**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Tapes.
 - 7. Securements.
 - 8. Corner angles.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Insulation."

1.2 QUALITY ASSURANCE

- A. 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.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - f. Johns Mansville
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
 - f. Johns Mansville

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

- e. Mon-Eco Industries, Inc.; 22-25.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 4. Color: White or gray.
- B. FSK Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic

Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 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.

2.5 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely

in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

PART 3 EXECUTION

3.1 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 demineralized water.

3.2 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 pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

- a. For below ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape 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.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping and fire-resistant joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 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.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using 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 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 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 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 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.

3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of 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 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. 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. 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.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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(s) 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, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. See plans for insulation schedule.

END OF SECTION

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SECTION 22 1116 - DOMESTIC WATER PIPING**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
- C. Related Section:
 - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items

1.2 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.
- D. All piping shall be tested for working pressure of 150 psi minimum and temperature of 210-degree Fahrenheit, as required by Minnesota code.

1.3 REFERENCE STANDARDS

- A. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings.
- B. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- C. NSF 61 - Drinking Water System Components - Health Effects.

PART 2 PRODUCTS**2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Fittings for NPS 2 (DN 50) and Smaller: ASME B16.51, wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

- b. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): NSF/ANSI 372, cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- 6. Copper Push-on-Joint Fittings:
 - a. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - b. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

2.4 PEX TUBE AND FITTINGS

- A. PEX piping acceptable located below floor, PEX piping not approved in exposed finished spaces.
- B. PEX Distribution System: ASTM F 877, SDR 9 tubing. System (tubing and fittings) shall be certified by independent third-party certifier.
- C. PEX Tube: ASMT F876, ASTM F877, NSF14 and NSF 61, with certification by independent third-party certifier.
- D. PEX Fittings: ASMT F1807, ASMT F1960, NSF14, NSF 61, ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
- E. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.
- F. CPVC piping and fittings shall also be compliant with ASMT F876, ASTM F877, NSF14 and NSF 61.
- G. This water distribution system shall be installed by a factory-trained installer in accordance with manufacturers installation instructions. Tubing and fittings must be marked with appropriate ASTM designations by manufacturer.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch-thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

2.9 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.
- Q. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."

- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
- G. Install supports for vertical steel piping every 15 feet.
- H. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 5. NPS 6: 48 inches with 3/4-inch rod.
 6. NPS 8: 48 inches with 7/8-inch rod.
- I. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- J. Install vinyl-coated hangers for PP-R piping with the following maximum horizontal spacing and minimum rod diameters and/or as indicated in local code whatever is LESS:
1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- K. Install hangers for vertical PP-R piping every 48 inches and/or as indicated in local code whatever is LESS.
- L. Install hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 32 inches with 3/8-inch rod.
 2. NPS 1-1/4 (DN 32) and Larger: 48 inches with 3/8-inch rod.
 3. Note: When installed with a continuous support such as PEX-a Pipe Support:
 4. NPS 3/4 (DN 20) and Smaller: 6 feet with 3/8-inch rod.
 5. NPS 1 (DN 25) and Larger: 8 feet with 3/8-inch rod.
- M. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

- a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
- b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; without joints.
 2. PEX tube, ASTM F877 or ASTM F 1960 connections
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6, shall be the following:
 1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 1. Soft copper tube, ASTM B 88, Type K; without joints.
 2. PEX tube, ASTM F877 or ASTM F 1960 connections
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- H. Aboveground domestic water piping, NPS 5 and NPS 6, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Strainers.
 - 5. Drain valves.
 - 6. Water hammer arresters.
- C. See Division 22 Section "Domestic Water Piping" for water meters.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data
 - 2. Product certificates
 - 3. Wiring Diagrams
 - 4. Test and Balance report
 - 5. Field quality-control reports.
 - 6. Warranty: Sample of special warranty.

PART 2 PRODUCTS**2.1 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.

4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1001.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
 - c. MIFAB
 2. Standard: ASSE 1012.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/2 or NPS 3/4.
 5. Body: Bronze.
 6. End Connections: , solder joint.
 7. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
 - c. MIFAB
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 7. Configuration: Designed for horizontal, straight through or vertical flow.
 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Provide full size hard copper drain line from unit to nearest floor drain.

C. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div.
 - b. Zurn Plumbing Products Group; Wilkins Div.
 - c. MIFAB
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 BALANCING VALVES**A. Memory-Stop Balancing Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Taco
 - h. ITT Bell and Gossett
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.4 STRAINERS FOR DOMESTIC WATER PIPING**A. Y-Pattern Strainers:**

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
 - c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: Pipe plug.

2.5 DRAIN VALVES**A. Ball-Valve-Type, Hose-End Drain Valves:**

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Wade
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.

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 backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. 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.
- E. Install Y-pattern strainers for water on supply side of each control valve, and pump.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

- H. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Primary, thermostatic, water mixing valves.
- I. 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."
- J. Install thermostatic recirculation valves in each domestic hot water return piping branch beyond last hot water device in that branch.
 - 1. Provide suitable line size isolation valves, unions, and strainer as indicated in piping detail shown on the drawings.
 - 2. Provide suitable access panel as required in non-accessible ceilings and walls.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and/or double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 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

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SECTION 22 1123 - DOMESTIC WATER PUMPS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.

1.2 SUBMITTALS

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

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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data
 - 2. Wiring Diagrams
 - 3. Warranty: Sample of warranty.

PART 2 PRODUCTS**2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Corporation.
 - 3. TACO Incorporated.
 - 4. Grundfos
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps, compliant with domestic water usage.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic.
 - 4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics: See schedule on plans for size, capacity and accessories.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

- A. None - Controlled through building lighting control panel, Provided and wired by electrical contractor

PART 3 EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install continuous-thread hanger rods of size required to support pump weight.
 1. Comply with requirements for hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Horizontally mounted, in-line, close-coupled centrifugal pumps.
 - b. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping."
 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties."
- D. Comply with Division 26 Sections for electrical connections and wiring methods.

3.3 ADJUSTING

- A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING**PART 1 GENERAL****1.1 SUMMARY**

- A. All plumbing shall be installed in accordance with code.
- B. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- C. Related Sections:
 - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 PRODUCTS**2.1 PIPING MATERIALS**

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Cellular-Core ABS Pipe: ASTM D 2661, Schedule 40, solid wall.
 - 1. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
 - 2. Solvent Cement and Adhesive Primer:

- a. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Cellular-Core PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil and waste Piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. ABS or PVC may not be used if horizontal lengths are greater than 35 feet in total length or greater than 35 feet in total height. ABS or PVC may not be used if located above a ceiling that is considered a mechanical plenum.
- F. Aboveground, soil, waste, and vent piping NPS 5 and larger shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. ABS or PVC may not be used if horizontal lengths are greater than 35 feet in total length or greater than 35 feet in total height. ABS or PVC may not be used if located above a ceiling that is considered a mechanical plenum.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping .
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- H. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- M. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

- O. Above ground ABS or PVC horizontal or vertical lengths greater than 30 feet in total length must be installed according to IAPMO 5-2006 and 9-2006. Thermal expansion and contraction may be controlled by offsets, expansion joints or restraints. Offsets must be 24 inches using 45-degree fittings every 30 feet. A cleanout must be provided in a drainage pipe for each aggregate horizontal change of direction exceeding 135 degrees. Cleanouts and expansion joints must be installed in an accessible location.
- P. ABS or PVC may not be used if located above a ceiling that is considered a mechanical plenum.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Use gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Install backwater valves in accessible locations.
 - 3. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. Spacing every other joint unless over 4 feet, then support each joint.
 - a. Support adjacent to joint not to exceed 18 inches.
 - b. Brace not to exceed 40-foot intervals to prevent horizontal movement.
 - c. Support at each horizontal branch connection.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
- J. Install supports for vertical ABS and PVC piping every 48 inches.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 - 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS**1.3 QUALITY ASSURANCE**

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS**2.1 CLEANOUTS**

- A. Exposed Cleanouts (CO):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #58510 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Wade
 - h. Sioux Chief
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: as required to match connected piping.
 - 5. Closure: Countersunk or raised-head, brass, cast-iron or plastic plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Floor Cleanouts (FCO):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #5600 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Mifab
 - h. Wade
 - i. Sioux Chief

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Adjustable housing.
 5. Body or Ferrule: to match piping.
 6. Clamping Device: Not required.
 7. Outlet Connection: Spigot or Threaded.
 8. Closure: Brass plug with straight threads and gasket, Cast-iron plug or Plastic plug to match body.
 9. Adjustable Housing Material: Cast iron or Plastic to match pipe with threads.
 10. Frame and Cover Material and Finish:
 11. Nickel-bronze, copper alloy for concrete floor & tile floor.
 12. Nickel-bronze, copper alloy with carpet tag (-14) for carpet floors.
 13. Frame and Cover Shape: Round.
 14. Top Loading Classification: Medium Duty.
 15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Wall Cleanouts (WCO):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #58790 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. Mifab
 - g. Wade
 - h. Sioux Chief
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: as required to match connected piping.
 5. Closure: Countersunk or raised-head, plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

- A. Floor Drains (X"FD):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #30000-A or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. Mifab
 - g. Wade
 - h. Sioux Chief
 2. Standard: ASME A112.6.3.
 3. With backwater valve where noted on plans.
 4. With Funnel where noted on plans.

5. With integral Cleanout where noted on plans.
6. Body Material: Match piping material.
7. Seepage Flange: Required.
8. Anchor Flange: Required.
9. Clamping Device: Required.
10. Outlet: Bottom.
11. Backwater Valve: Integral, ASME A112.14.1, swing-check type where noted on plans.
12. Coating on Interior and Exposed Exterior Surfaces: Not required.
13. Sediment Bucket: Not required.
14. Top or Strainer Material: Nickel bronze.
15. Top of Body and Strainer Finish: Nickel bronze.
16. Top Shape: Round.
17. Dimensions of Top or Strainer: 5"
18. Top Loading Classification: Medium Duty.
19. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection where noted on plans.

2.3 FLOOR SINKS

A. Floor Sinks (X"FS):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide Josam #49000 or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - f. Mifab
 - g. Wade
4. Standard: ASME A112.6.3 With backwater valve where noted on plans.
5. Pattern: Deep basin drain with ½ grate.
6. Body Material: Gray iron.
7. Seepage Flange: Required.
8. Anchor Flange: Required.
9. Clamping Device: Required.
10. Outlet: Bottom.
11. Backwater Valve: Drain-outlet type where noted on plans.
12. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
13. Sediment Bucket: Aluminum.
14. Top or Strainer Material: ductile iron.
15. Top of Body and Strainer Finish: ductile iron.
16. Top Shape: Square.
17. Dimensions of Top or Strainer: 12x12
18. Top Loading Classification: Medium Duty.

19. Funnel: Not required.
20. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

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 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

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

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SECTION 22 3300 - ELECTRIC, DOMESTIC-WATER HEATERS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- 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. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.

PART 2 PRODUCTS**2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS**

- A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. A.O. Smith
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.

- d. PVI Industries, LLC.
 - e. Rheem Manufacturing Company.
 - f. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - g. State Industries.
 2. Standard: UL 174.
 3. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1.
 - e. Jacket: Steel with enameled finish.
 - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 5. Special Requirements: NSF 5 construction with legs for off-floor installation.
- B. Capacities and Characteristics:
1. See schedule on plans for size, recovery, capacities, dimensions, voltage, etc.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Compression Tanks:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMTROL Inc.
 - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - c. State Industries.
 - d. Taco, Inc.
 2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 4. Capacity and Characteristics:
 - a. See schedule on plans for size, recovery, capacities, dimensions, voltage, etc.

- B. Corrosion-resistant metal with 4" raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Anchor domestic-water heaters per manufacturers instructions.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."

- E. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- F. Fill electric, domestic-water heaters with water.
- G. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 22 4000 - 4000 – PLUMBING FIXTURES**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Adjust list below to suit Project.
 - 2. Faucets for lavatories, showers and sinks.
 - 3. Protective Shielding Guards
 - 4. Fixture Supports
 - 5. Water closets.
 - 6. Lavatories.
 - 7. Stainless Steel sinks

1.2 DEFINITIONS

- 1. Retain abbreviations and terms that remain after this Section has been edited.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 2. Vitreous-China Fixtures: ASME A112.19.2M.
- F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Retain only subparagraphs below that match faucets, components, and features specified.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 5. Hose-Coupling Threads: ASME B1.20.7.
 - 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.

7. NSF Potable-Water Materials: NSF 61.
 8. Pipe Threads: ASME B1.20.1.
 9. Supply Fittings: ASME A112.18.1.
 10. Brass Waste Fittings: ASME A112.18.2.
- G. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Retain only subparagraphs below that match faucets, components, and features specified.
 2. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 3. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 4. Faucets: ASME A112.18.1.
 5. Hand-Held Showers: ASSE 1014.
 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 7. Hose-Coupling Threads: ASME B1.20.7.
 8. Manual-Control Antiscald Faucets: ASTM F 444.
 9. Pipe Threads: ASME B1.20.1.
 10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Retain only subparagraphs below that match fittings and features specified.
 2. Atmospheric Vacuum Breakers: ASSE 1001.
 3. Brass and Copper Supplies: ASME A112.18.1.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Retain only subparagraphs below that match components and features specified.
 2. Flexible Water Connectors: ASME A112.18.6.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Off-Floor Fixture Supports: ASME A112.6.1M.
 5. Pipe Threads: ASME B1.20.1.
 6. Plastic Toilet Seats: ANSI Z124.5.
 7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 REFERENCE STANDARDS

- A. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.2 PLUMBING FIXTURE SCHEDULE

- A. Fixture numbers below refer to the fixture numbers on the drawings.
- B. L1 - Wall Mounted – ADA
1. Fixture: Wall hung, white vitreous china, 20" x 18" nominal dimensions, rear overflow, center faucet hole. American Standard #9024.001EC, No Substitutions.

2. Faucet: Manual operated, single lever faucet, ADA compliant, vandal resistant aerator, 1.2 GPM flow, chrome finish, single centerset. Manufacturers: Moen #84505, No Substitutions.
 3. Drain: Grid strainer with 1-1/4" offset tailpiece, adjustable offset p-traps, 17 gauge tubing waste to wall, chrome escutcheon.
 4. Supply: 3/8" wall supplies, escutcheon plate, flexible tube riser, loose key stops with chrome finish .
 5. Thermostatic mixing valve - ASSE 1070, lead free, internal strainer, below deck, tamper resistant, Bdual check valves, Watts LFUSG-B or equal
 6. Wrap: flexible vinyl insulate waste and water supply piping covers complete with internal ribs, out of sight fastening system and weep hole in base of trap. Manufacturer: Truebro Lav Guard2.
 7. Provide floor mounted concealed arm support for new lavatory. Provide wall mounting bracket for existing location.
- C. WC1 - Floor Mounted – ADA Tank – Comfort Height Elongated Bowl, Handicap, 1.6 gpf Gravity
1. Fixture: vitreous china floor set tank type water closet, ADA compliant, with elongated 16-1/2" high bowl, 1.6 gallon flush, EPDM 3" flush valve, 2-1/8" glazed trapway, 12" rough-in and bolt caps. Provide with chrome lever installed on wide stall side of tank. Color shall be "white". Manufacturer: American Standard # 215AA005.020, No Substitutions.
 2. Seat: Heavy duty solid plastic for elongated bowl, open front with cover, white, stainless steel posts. Manufacturer: Bemis 1655SSCT.
 3. Contractor to field verify rough-in on existing toilet.
- D. S1 – Counter Mounted SS sink
1. Fixture: double compartment self rimming stainless steel sink of seamlessly drawn 20 gauge stainless steel. The bowl shall be 6." deep, polished satin finish, heavy duty under coating, recessed faucet deck, and 3 1/2" drain opening. Manufacturer: American Standard # 22DB.6332283S.075, No Substitutions.
 2. Faucet: deck mounted faucet – two function pull-out spray head, 6-5/8" high arch gooseneck spout, single handle, one hole installation, ADA, Manufacturers: Moen # 87039, No Substitutions.
 3. Drain: basket strainer for 3 1/2" opening, strainer, neoprene stopper, and 1 1/2" cast brass tail piece.
 4. Supply: 1/2" wall supplies, escutcheon plate, flexible tube riser, loose key stops with chrome finish .
- E. Shower Faucet, ADA
1. Shower Valve, Shower Head:
 - a. UT2901 pressure balance valve & trim
 - b. 6399EP shower head
 - c. 214107 / 10154 shower arm and flange
 - d. Manufacturer: Moen #UT2902EP, No Substitutions.
- F. WSH1 Washer Box :
1. Recessed clothes washer connection box complete with hose bibs for hot and cold water, water hammer arrestors, and vented 2" stand pipe for the washer drain hose, all in a recessed box for standard wall thickness. Manufacturers: Guy Gray #WB200HA (Or Equal)

PART 3 EXECUTION

3.1 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.
 - 4. First paragraph below applies to wall-mounting fixtures such as water closets and urinals.
- 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 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 "Escutcheons for Plumbing Piping."
 - 1. Delete paragraph below if sealants are specified in Division 07 Section "Joint Sealants."
- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.4 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

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SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Floor plates.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Supports and anchorages.
- B. Related Sections:
 - 1. Division 01 Section "Project Management and Coordination" for requirements related to each subcontractor's responsibility to complete coordination drawings and submit.
 - 2. Division 01 Section "Closeout Submittals" for requirements related to each subcontractor's responsibility to submit record drawing to the owner as part of the operation and maintenance data.

1.2 DEFINITIONS

- A. Refer to General Conditions for additional definitions.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Shop Drawings: CAD generated drawings and drawn to 1/8 inch equals 1 foot scale. The common/public areas and the entire mechanical room shall require CAD generated drawings and drawn to 1/4 inch equals 1 foot scale. The following components shall be noted on the drawing for the purpose of coordination with other trades and based on input from installers of the items involved:
 - 1. Duct layout indicating sizes.
 - 2. Elevations of top and bottom of ducts.

3. Penetrations through fire-rated and other partitions.
 4. Equipment installation based on equipment being used on Project.
 5. Duct accessories, including access doors and panels.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 COORDINATION

- A. This Contractor shall coordinate with other trades in the installation of equipment, piping, conduit, and ductwork.
- B. The HVAC/ Sheet-Metal Contractor shall initiate the coordination process by providing reproducible plan drawings showing ductwork and equipment. The HVAC/Sheet-Metal Contractor shall forward the drawings to the Piping Contractor, Fire Protection Contractor, and Electrical Contractor for inclusion of their systems work. The HVAC/Sheet-Metal Contractor shall be responsible for retrieving all drawings from necessary contractors and developing necessary drawings highlighting conflicting areas.
- C. Following the completion of these drawings, an on-site coordination meeting shall be convened, and attended by all the above contractors, and the Mechanical and Electrical design Engineers for the purpose of review and coordination. This meeting allows the opportunity for all contractors to resolve coordination issues prior to the fabrication and installation of materials. Coordination meeting shall take place before any work is started. No additional cost to the project will be accepted for any coordination related items if this process is not adhered to.

1.6 PREFABRICATION

- A. If a contractor elects to prefabricate piping and ductwork, they are still obligated to abide by all requirements for cooperation with other trades. they shall not assume that his material will be installed first and other trades must follow.
- B. If changes are made by the architect/engineer reasonably in advance of anticipated installation, the Owner shall not be penalized with added cost because materials were prefabricated in advance.

PART 2 PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: glass reinforced nylon or plastic Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.

2.7 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.11 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- C. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.12 FLOOR PLATE INSTALLATION

- A. Install floor plates for piping penetrations of equipment-room floors.
- B. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.

3.13 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Protect grout from disturbances during curing.

END OF SECTION

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SECTION 23 0513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS**2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency, as defined in NEMA MG 1:
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 4. All motors shall be provided with manufacturer installed shaft grounding kit.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 23 0517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.
- B. Related Requirements:
 - 1. Section 07 8413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 PRODUCTS**2.1 SLEEVES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20-psig.
 - 3. Sealing Elements: High-temperature-silicone interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.

2.3 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S,

Grade NS, Class 25, use NT.

- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 8413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls Above Grade:
 - a. Piping Smaller Than NPS 6 : Steel-pipe sleeves .
 - b. Piping and Larger: .
 2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller Than NPS 6 : Steel-pipe sleeves with sleeve-seal system .
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping and Larger: .
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 3. Concrete Slabs Above Grade:
 - a. Piping Smaller Than NPS 6 : Steel-pipe sleeves .
 - b. Piping and Larger: .
 4. Interior Partitions:
 - a. Piping Smaller Than NPS 6 : Galvanized-steel pipe sleeves .
 - b. Piping and Larger: .

END OF SECTION

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SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Inserts.
 - 3. Pipe insulation shields.

1.2 ABBREVIATIONS AND DEFINITIONS

- A. MFMA: Metal Framing Manufacturers Association.
- B. MSS: Manufacturer's Standardization Society for the Valve and Fittings Industry, Inc.
- C. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

PART 2 PRODUCTS**2.1 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Coatings, where designated:
 - a. Pre-galvanized or hot dipped for hangers supporting steel pipes.
 - b. Plastic coated riser clamps for DX and chilled water vertical pipe supports.
 - c. Copper clad for hangers supporting bare copper pipes and tubing.
 - 3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi minimum compressive strength and vapor barrier.
- B. For Trapeze or Clamped Systems: Cover entire pipe circumference with inserts.
- C. For Clevis or Band Hangers: Cover lower 180 degrees of pipe with inserts.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 INSULATION SHIELDS

- A. Insulation Shield for Trapeze or Clamped Systems: cover entire pipe circumference.
- B. Insulation Shield for Clevis or Band Hangers and Saddles: lower 180 degrees of pipe.

PART 3 EXECUTION**3.1 HANGER AND SUPPORT INSTALLATION**

- A. Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments to properly support piping from the building structure.
- B. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- C. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- D. Install lateral bracing with pipe hangers and supports to prevent swaying.
- E. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- G. Insulated Piping:
 - 1. Install hanger rods with enough adjustment to support piping before and after insulating.
 - 2. Piping Operating above Ambient Air Temperature: Clamps and hangers may project through insulation, with sealed ends of insulation butting up to clamps and hangers.
 - 3. Piping Operating below Ambient Air Temperature:
 - a. Size hangers for outer circumference of pipe insulation.
 - b. Use high density full circumference insulation inserts and full circumference shields at hangers supporting insulated piping 2" and larger.
 - c. Use MSS Type 39 carbon steel insulation saddle and insulation inserts to support piping 4" and larger. Use pipe roller supports for supporting saddles.
 - d. Use plastic coated riser clamps for vertical pipe applications. Insulate the riser clamp and provide vapor barrier mastic to insulated clamp.
 - e. Use plastic coated pipe clamps for pipe anchors, where anchors are indicated. Insulate the pipe and clamp and provide vapor barrier mastic to insulated clamp.
 - 4. Install MSS SP-58, Type 40 protective metal shield at each support.
 - a. Shield Dimensions for Pipe: Not less than the following:
 - 1) NPS 1/2 to NPS 3: 12 inches long and 0.048 inch thick.
 - 2) NPS 4: 12 inches long and 0.06 inch thick.
 - 3) NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 4) NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - 5) NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 4 and Larger: Unless carbon steel saddle and rollers are provided, include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

3.2 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods.

3.3 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- E. Use padded hangers for non-metallic piping.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

END OF SECTION

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SECTION 23 0553 - IDENTIFICATION FOR HVAC EQUIPMENT**PART 1 GENERAL****1.1 SUMMARY**

A. Section Includes:

1. Equipment labels.

PART 2 PRODUCTS**2.1 EQUIPMENT LABELS**

A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number,

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Include equipment schedule in operation and maintenance data.

2.2 DUCT LABELS

A. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Duct Labels: Precoiled, semirigid plastic formed to partially cover circumference of duct and to attach to duct without fasteners or adhesive.
- C. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Duct Label Contents: Include identification of ducts service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Coordinate installation of identifying devices with locations of access panels and doors.

3.3 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 PRODUCTS (NOT APPLICABLE)**PART 3 EXECUTION****3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.

- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Duct systems are complete with terminals installed.
 - b. Volume, smoke, and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. Fans are operating, free of vibration, and rotating in correct direction.
 - e. Automatic temperature-control systems are operational.
 - f. Ceilings are installed.
 - g. Windows and doors are installed.
 - h. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and

Balancing" and in this Section.

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 3300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 0713 "Duct Insulation," Section 23 0716 "HVAC Equipment Insulation," and Section 23 0719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 23 3113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:

- a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. See the Evaluations for discussion of fan-speed adjustments.
 5. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.

3.6 TOLERANCES

- A. Set HVAC system's airflow rates
- B. 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.
- C. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.7 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.

2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Balancing stations.
 5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.

- e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
- 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch (mm) o.c.
 - f. Make and model number.
 - g. Face area in sq. ft. (sq. m).
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig (kPa).
 - j. Refrigerant suction temperature in deg F (deg C).
 - k. Inlet steam pressure in psig (kPa).
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.

- f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - d. Air temperature differential in deg F (deg C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F (deg C).
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in cfm (L/s).
 - i. Face area in sq. ft. (sq. m).
 - j. Minimum face velocity in fpm (m/s).
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:

- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft. (sq. m).
 2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
- L. System-Coil Reports: For reheat coils of terminal units, include the following:
1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
- M. Instrument Calibration Reports:
1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.8 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner or Construction Manager.
- B. Owner or Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 3. Retain subparagraph below if TAB specialist is a certified AABC specialist.
 4. If the second verification also fails, Owner or design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.9 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0700 - HVAC INSULATION**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Mineral/glass fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Sealants.
 - 5. Factory-applied jackets.
 - 6. Tapes.
 - 7. Fasteners.
- B. Related Sections:
 - 1. Division 23 Section "Metal Ducts" for duct liners.

1.2 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics per ASTM E84:
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

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. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 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.
- E. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal

density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu-in./h-sq. ft.-deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
- D. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 3. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: Aluminum.

2.5 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.

2.6 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.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 FASTENERS

- 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. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 EXECUTION**3.1 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 demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- 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.
 - 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.
- 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.
 - a. For below ambient services, stapling is not permitted.
 - b. Seal seam joints with tape.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, stapling is not permitted.
 - b. Seal seam joints with tape.
 - 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 duct and pipe flanges and fittings.

- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 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.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, 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.

3.6 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.
- E. 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 80 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.

- f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 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. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- 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 80 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 DUCT INSULATION SCHEDULE, GENERAL

- A. See plans for insulation schedule.
- B. Items Not Insulated:
 1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

END OF SECTION

SECTION 23 0993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes control components and sequences for HVAC systems, subsystems, and equipment.
- B. Mechanical contractor is responsible for all low voltage control wiring, accessories, components etc for a full and operational systems.
- C. All control wiring shall be installed in conduit. Conduit runs shall be installed high near roof deck in exposed structure areas. Provide corrosion resistant conduit in wash bay.

1.2 ADJUSTABLE VARIABLES

- A. Modify software to allow adjustment of parameters, settings, limits, alarm conditions, throttling ranges, deadbands, variables, etc. by the operator.
- B. Global settings (initial values):
 - 1. Zone Temperature:
 - a. Heating: 72 degrees F. occupied mode, 65 degrees F. unoccupied mode.
 - b. Cooling: 74 degrees F. occupied mode, 80 degrees F. unoccupied mode.

1.3 ABBREVIATIONS

- A. DAT – discharge air temperature (usually supply duct temperature).
- B. Deg or degrees – degrees Fahrenheit.
- C. LAT – leaving air temperature (usually after passing through heating or cooling coil).
- D. MA/MAT – mixed air / mixed air temperature (leaving AHU and RTU filter section).
- E. OA/OAT – outside (ambient) air / outside air temperature.
- F. RA/RAT – return air / return air temperature.
- G. rh – relative humidity
- H. SA/SAT – supply air / supply air temperature.
- I. T – temperature (degrees Fahrenheit).

1.4 OPERATIONAL MODES

- A. Occupied Mode
 - 1. Maintain zone temperatures at zone temperature settings.
 - 2. Maintain zone humidity at zone humidity settings (where applicable).
 - 3. The building is occupied from 8:00 am to 5:00 pm Monday through Friday.
 - 4. The building is occupied from 8:00 am to 12:00 pm Saturday.
 - a. Remove occupied mode scheduling for Holidays and other one-time events on a global basis and a unit by unit basis. Consult Owner for Holiday occurrences and timeframes.
- B. Unoccupied Mode
 - 1. Occurs when equipment is not in occupied or start-up mode.
 - 2. Close outside air (ventilation) dampers.

3. Maintain spaces at (or above) setback temperature settings when O.A. temperatures are below occupied settings. Allow temperature drift in this mode.
 4. Maintain spaces at (or below) setup temperature and humidity settings when O.A. temperatures are above occupied settings. Allow temperature drift in this mode.
 5. The unoccupied mode begins when the occupied mode ends and continues until the optimal start control initiates start-up mode.
- C. Dehumidification
1. Occurs with space humidity level rises above set point.
 2. Furnace cooling activates.
- D. Start-up Mode
1. Occurs prior to occupied mode. Optimal start control commands each system to reach occupied mode conditions while outside air dampers remain closed.

PART 2 OPERATING SEQUENCE

2.1 FANS:

- A. Controlled through Ventilation control panel, interlocked intake louver damper L-x. See section 2.4 below.
- B. Controlled by occupancy sensor or lighting control panel, provided and installed by electrical contractor.

2.2 FURNACE:

- A. Room Temperature:
1. Input Device: Provide Honeywell Commercial VisionPro 8000 commercial (or Equal) 2 Heat / 2 Cool zone thermostat to be interfaced with the furnace controls, capable of carrying out the furnace sequence of operation. The override shall be push button and shall remain on for a duration of 1 hour. Provide outside air sensor & additional sensors as required for operation of furnace.
 2. Honeywell controls shall be installed, wired and programmed by a factory trained technician or contractor. All low voltage wiring control wiring by this contractor, line voltage shall be coordinated and installed with electrical contractor.
 - a. Action:
 - b. Occupied mode:
 - 1) The fan shall run continuously and outside air damper open.
 - 2) On a call for heat, the first burner stage is energized to meet the heating space setpoint temperature. Upon a further call for heat, the second burner stage is energized to meet the heating space setpoint temperature.
 - 3) On a call for cooling, first & second stage DX cooling stages to meet space setpoint temperature.
 - c. Unoccupied mode:
 - 1) The fan shall run cycle on call for heating or cooling and outside air damper shall be closed.
 - 2) On a call for heat, outside air damper shall remain closed. the first burner stage is energized to meet the heating space setpoint temperature. Upon a further call for heat, the second burner stage is energized to meet the heating space setpoint temperature.

- 3) On a call for cooling, outside air damper shall remain closed, DX cooling stages to meet space setpoint temperature.

2.3 EXHAUST FAN CONTROL EF-X & LOUVER L-X

A. Gas Detection Equipment

1. Manufacturers:
 - a. Macurco
 - b. American Gas Safety (AGS)
 - c. Toxalert
 - d. Honeywell Analytics Inc- E3 Point
2. General
 - a. Provide a networked system for sensing, controlling and monitoring gas fumes including control panels, sensors and wiring.
 - b. All control wiring shall be low voltage and installed by mechanical contractor.
 - c. Sensors shall be capable monitoring Carbon Monoxide (CO) and Nitrogen Dioxide (NO₂).
3. System Controller
 - a. The system controller shall continuously monitor its remote sensors. When an alarm condition is detected the controller shall delay exhaust fan contact closure for 30 seconds. If the high gas level condition persists for more than 30 seconds the exhaust fan contacts shall close. The minimum fan ON time shall be field settable from 5 to 55 minutes, in 5 minute increments. Should the alarm condition remain after the minimum run time has timed out, the exhaust fan contacts shall remain closed (ON) and a second "alarm" set of contacts shall close.
 - b. The controller shall be powered by 24vac, 60Hz, 0.4A (fused) and provide all low voltage power to remote sensors. 24 vac, 2A resistive, 1.5A inductive auxiliary relay contacts shall be provided for remote control.
 - c. Provide clearly labeled light emitting diodes (LED's) on face of the controller panel to indicate the following:
 - 1) Power "ON" to system - Green LED
 - 2) Red LED for each sensor to indicate high gas level conditions (warning & alarm levels).
 - 3) Amber LED to indicate Fan On.
 - 4) Red LED to indicate Alarm condition.
 - d. Provide an audible alarm with a minimum sound intensity of 85dB at 3 meters, on the face of the control panel. Provide an "Audible Reset" push button switch to silence the audible. Audible silence circuit shall be self resetting so that after alarm is cleared the audible alarm will automatically resound on the next alarm activation.
 - e. Provide remote 0-60 minute manual timer switch to override ventilation control panel to allow operation of make-up air unit and exhaust fan.
4. Remote Sensors:
 - a. Plug and Play remote sensors
 - b. Carbon Monoxide Sensor (CO) and Nitrogen Dioxide (NO₂)
 - c. Catalytic bead sensor performance
 - d. Uses Reflex and smart cartridge technologies
 - e. Factory-calibrated replacement cartridges
 - f. Power transformer
 - g. Horns and strobes

- B. The controls described apply to the following equipment with zoned fume detection.
 - 1. DII: EF-2 interlocked with louvers (1) L-2
 - 2. DII: EF-3 interlocked with louvers (3) L-1
 - 3. DII: EF-5 interlocked with louvers (1) L-2
 - 4. DIII: EF-3 interlocked with louvers (3) L-1
- C. Input Devices:
 - 1. Gas detection system with Carbon Monoxide and Nitrogen Dioxide sensors furnished and wired by mechanical contractor. Energize EF-x and open louver damper L-x on upon detection of CO (20 ppm) and NO₂ (1 ppm) (not exceed max PEL)
 - 2. Low voltage timer switch (0-60 minutes) provided and wired by mechanical contractor. Timer switch shall energize EF-x and associated Louver L-X.

2.4 UNIT HEATER – GAS-FIRED

- A. Input Device:
 - 1. Low voltage wall-mounted thermostat. Provide by manufacturer, wired by Mechanical contractor.
- B. Operational Mode
 - 1. Upon a drop in the space temperature below space temperature setpoint 70 F(adj.), start fan and energize burner on to meet space setpoint temperature.

2.5 DOMESTIC RECIRC PUMP

- A. Recirc pump (PP-1) control by lighting control panel, provided and installed by electrical contractor. Pump to start based on scheduled time, or shall run continuously based building usage.

END OF SECTION

SECTION 23 1126 - FACILITY LIQUEFIED-PETROLEUM GAS PIPING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Pipe, pipe fittings, valves, and connections for propane gas piping systems.

1.2 REFERENCE STANDARDS

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.
- B. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators.
- C. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- G. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
- H. ASME B31.1 - Power Piping.
- I. ASME B31.9 - Building Services Piping.
- J. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- P. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
- Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- R. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- S. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- U. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- V. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- W. AWWA C606 - Grooved and Shouldered Joints.
- X. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
- Y. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
- Z. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

- AA. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- BB. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- CC. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends.
- DD. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- EE. NFPA 58 - Liquefied Petroleum Gas Code.

1.3 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 PROPANE GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - 2. Joints: ASME B31.1, welded.
- B. Flexible Gas Piping:
 - 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 - 2. Fittings: Provided by piping system manufacturer.
 - 3. Manufacturers:
 - a. Omega Flex, Inc; TracPipe PS-II: www.omegaflex.com/#sle.
- C. Polyethylene Pipe: ASTM D2513, SDR 11.
 - 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
 - 2. Joints: Fusion welded.

2.2 PROPANE GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: ASME B31.1, welded.
- B. Copper Tube: ASTM B88 (((ASTM B88M))), Type K (A) annealed.
 1. Fittings: ASME B16.26, cast bronze.
 2. Joints: Flared.
- C. Copper Tube: Listed, ASTM B88 (((ASTM B88M))), Type K (A), annealed.
 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
 3. Mechanical Press Sealed Fittings: Double-pressed type and approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
- D. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Fittings: Provided by piping system manufacturer.

2.3 PROPANE GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 2. Joints: NFPA 58, threaded or welded to ASME B31.1.
- B. Copper Tube: ASTM B88 (((ASTM B88M))), Type K (A) annealed.
 1. Fittings: ASME B16.26, cast bronze.
 2. Joints: Flared.
- C. Copper Tube: Listed, ASTM B88 (((ASTM B88M))), Type K (A), annealed.
 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
 3. Mechanical Press Sealed Fittings: Double-pressed type and approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
- D. Flexible Gas Piping:
 1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
 2. Comply with ASTM E84.
 3. Fittings: Provided by piping system manufacturer.
 4. Provide piping with integral lightning protection.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch:
 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Housing Material: Provide ASTM A47/A47M malleable iron, ductile iron, or _____, galvanized.

3. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
 4. Gasket Material: Nitrile rubber suitable for operating temperature range from minus 20 degrees F to 180 degrees F.
 5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
 7. Manufacturers:
 - a. Apollo Valves
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
 6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
- B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.6 BALL VALVES

- A. Manufacturers:
1. Apollo Valves
 2. Grinnell Products
 3. Milwaukee Valve Company
 4. Nibco, Inc
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, ductile iron, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved with

union.

2.7 PLUG VALVES

- A. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.8 STRAINERS

- A. Manufacturers:
 - 1. Armstrong International, Inc
 - 2. Green Country Filter Manufacturing
 - 3. WEAMCO
- B. Size 2 inch and Under:
 - 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 1-1/2 inch to 4 inch:
 - 1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- D. Size 5 inch and Larger:
 - 1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Manufacturers:
 - 1. Actaris Metering Systems (A brand of ITT Controls)
 - 2. Dungs Combustion Controls
 - 3. Maxitrol Company
- B. Compliance Requirements:
 - 1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
 - 2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
- C. Materials in Contact With Gas:
- D. Maximum Inlet Operating Pressure: 10 psi.
 - 1. Appliance Regulator: 10 psi.
 - 2. Line Pressure Regulator: 10 psi.
- E. Maximum Body Pressure: 10 psi.
- F. Output Pressure Range: 1 inch wc to 80 inch wc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
 - 1. Coordinate size and location of access doors with Section 08 3100.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
 - 1. Painting of interior plumbing systems and components is specified in Section 09 9123.
 - 2. Painting of exterior plumbing systems and components is specified in Section 09 9113.
- L. Excavate in accordance with Section 31 2316.
- M. Excavate in accordance with Section 31 2316.13.
- N. Backfill in accordance with Section 31 2323.
- O. Backfill in accordance with Section 31 2316.13.
- P. Install valves with stems upright or horizontal, not inverted.
- Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- R. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- S. Sleeve pipes passing through partitions, walls and floors.
- T. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- U. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - a. Painting of interior plumbing systems and components is specified in Section 09 9123.
 - b. Painting of exterior plumbing systems and components is specified in Section 09 9113.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; see Section 23 0548.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Provide plug valves in natural gas systems for shut-off service.

3.5 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators in accordance with Section 33 5216. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.6 SCHEDULES

- A. Pipe Hanger Spacing:
 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe size: 4 inches to 6 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.

- e. Pipe size: 8 inches to 12 inches:
 - 1) Maximum Hanger Spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.
- f. Pipe size: 14 inches and Over:
 - 1) Maximum Hanger Spacing: 20 ft.
 - 2) Hanger rod diameter: 1 inch.

END OF SECTION

SECTION 23 3113 - METAL DUCTS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data

PART 2 PRODUCTS**2.1 RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in

SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 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 (Substitutions: See Section 01 600 – Product Requirements):
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., 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."
 - 1. 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.
- 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."
- E. Long Sweep Elbows: 26 gauge aluminized steel, zero code required run-length reduction.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - a. In-O-Vate Technologies, Inc., The DRYER-ELL.

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheet Metal: comply with ASTM B-316 - where noted on plan
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled matte finished for exposed ducts.

- E. Stainless-Steel Sheets: Comply with ASTM A 480 / A 480M, Type 304 or 316, as indicated in the duct schedule. Cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the duct schedule.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.
- G. 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.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - 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. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 3 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. 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.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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."

3.4 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.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
 - 1. Ducts Connected to Self Contained Units, Fan Coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 - 2. Ducts Connected to Rooftop Units, Energy Recovery Units, Make-up air units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:

1. Ducts Connected to Self Contained Units, Fan coil Units, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 2. Ducts Connected to Rooftop Units, Energy Recovery Units, Make-up Air units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- E. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
- F. Liner:
1. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - a. Last 10 feet before connection to air handling equipment.
 2. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- G. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. 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."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
 - d. Long Sweep Elbows: Utilize for dryer exhaust, bath fan exhaust and kitchen hood exhaust.
- H. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3300 - AIR DUCT ACCESSORIES**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Actuators
 - 3. Motorized dampers
 - 4. Turning vanes.
 - 5. Duct-mounted access doors.
 - 6. Flexible ducts.
 - 7. Duct accessory hardware.
 - 8. Wall caps.
- B. Related Sections:
 - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items

1.2 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 PRODUCTS**2.1 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. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 60 .00 – Product Requirements):
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. Cesco Products; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.

- d. Ruskin Company.
- 2. Standard leakage rating.
- 3. Suitable for horizontal or vertical applications.
- 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Molded synthetic.
 - b. 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.
- 8. Tie Bars and Brackets: Galvanized steel.

2.3 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

- f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
- 4. Coupling: V-bolt and V-shaped, toothed cradle.
- 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
- 7. Power Requirements (Two-Position Spring Return): see plans.
- 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc. Coordinate with Division 26.
- 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
- 10. Temperature Rating: Minus 22 to plus 122 deg F.
- 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
- 12. Run Time: 12 seconds open, 5 seconds closed.

2.4 MOTORIZED DAMPERS

- A. Manufacturers:
 - 1. Pottorf
 - 2. Ruskin
 - 3. TAMCO (T. A. Morrison & Co. Inc.).
- B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 4 cfm per sq. ft. of damper area, at differential pressure of 1-inch wg when damper is tested according to AMCA 500.
 - 5. For lowleakage applications (outside air intake hoods, relief/exhaust air outlet hoods and exhaust fan outlet openings as shown on the drawings), use Tamco Model 9000 SC or Ruskin CDTI-50; there is no equal for these products.

2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. METALAIRE, Inc.
 - 3. SEMCO Incorporated.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 60 .00 – Product Requirements):
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Greenheck Fan Corporation.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 60 .00 – Product Requirements):
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 60 .00 – Product Requirements):
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 20 to plus 175 deg F.

2.9 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.

2.10 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cesco Products; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. McGill AirFlow LLC.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Ruskin Company.
- B. Frames:
 - 1. Hat shaped.
 - 2. 94-inch-thick, galvanized sheet steel.
 - 3. Interlocking, gusseted corners.
- C. Blades:
 - 1. Multiple blade with maximum blade width of 6 inches.
 - 2. Parallel- and opposed-blade design.
 - 3. Galvanized-steel.
 - 4. 47-inch-thick dual skin.
 - 5. Blade Edging: Closed-cell neoprene.
- D. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
 - 1. Oil-impregnated bronze.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.11 WALL CAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Primex
- B. Material: Polymer resin. Color selected by the Architect from manufacturer's standard colors.
- C. Mounting: Collar to match duct size.
- D. Style:
 - 1. Brick walls: WCX Series
 - 2. All other walls: WC Series

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.
- 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 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.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install fire/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. At outdoor-air intake plenums.
 - 2. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire 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.
 - 3. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Install flexible connectors to connect ducts to equipment.
- K. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.
- L. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- M. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- N. 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 fire/smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper

END OF SECTION

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SECTION 23 3423 - HVAC POWER VENTILATORS**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. In-line centrifugal fans.
 - 2. Ceiling mounted ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- 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. Wiring Diagrams

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data
 - 2. Product certificates
 - 3. Wiring Diagrams
 - 4. Warranty: Sample of warranty.
 - 5. 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 PRODUCTS**2.1 IN-LINE CENTRIFUGAL FANS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Carnes Company.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. PennBarry.
 - 5. S&P.
 - 6. Twin City Fan.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 3. Companion Flanges: For inlet and outlet duct connections.
 - 4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

2.2 CEILING- OR WAL-MOUNTING VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (Substitutions: See Section 01 600 – Product Requirements):
 - 1. Greenheck
 - 2. Loren Cook Company.
 - 3. Broan
 - 4. Twin City Fan.
- B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Painted galvanized, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 3. Companion Flanges: For inlet and outlet duct connections.
 - 4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
 - 6. Wall caps, where required, shall be galvanized metal.
 - 7. Radiation damper as required for UL rated floor/ceiling assemblies.

2.3 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.4 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.

- C. Comply with requirements in Section 23 059 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Round ceiling diffusers.
 - 2. Rectangular and square ceiling diffusers.
 - 3. Louver face diffusers.
 - 4. Adjustable bar registers and grilles.
 - 5. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

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.
 - 3. Color chart.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following
 - 1. Anemostat
 - 2. Krueger.
 - 3. Price.
 - 4. Titus.
 - 5. Nailor
- B. Provide thermally adjustable diffusers manufactured by Acutherm.

2.2 CEILING DIFFUSERS

- A. See schedule on plans for type, size and color.

2.3 REGISTERS AND GRILLES

- A. See schedule on plans for type, size and color.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 3724 - LOUVERS**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Fixed, extruded-aluminum and formed-metal louvers.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. 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. Samples: For each type of metal finish required.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 3. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 4. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Greenheck Fan Corporation.
 - b. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - c. National Controlled Air
 - d. Pottorff
 - e. Ruskin Company; Tomkins PLC.
 - 2. Louver Depth: 4 inches.
 - 3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
 - 4. Louver Performance Ratings:
 - a. See schedule on plans for size and performance.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
- B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening:
 - 1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.5 ALUMINUM FINISHES

- A. Provide finish selected from manufacturers standard colors. Color to be selected by architect during shop drawing process.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate and place louvers plumb, and at indicated alignment with adjacent work.
- B. 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.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. 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.
- E. 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

SECTION 23 5400 - FURNACES**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Gas-fired, condensing furnaces and accessories complete with controls.
 - 2. Air filters.
 - 3. Refrigeration components.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:
 - 1. Furnace.
 - 2. Refrigeration components
- B. Operation and maintenance data.
- C. Warranty.

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."
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. Comply with NFPA 70.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
 - 1. Warranty Period, Commencing on Date of Substantial Completion:
 - a. Furnace Heat Exchanger: 10 years.
 - b. Parts: 5 years.

PART 2 PRODUCTS**2.1 GAS-FIRED FURNACES, CONDENSING**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. 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. Lennox – No Substitutions

- D. General Requirements for Gas-Fired, Condensing Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3, "Gas-Fired Central Furnaces," and with NFPA 54.
- E. Cabinet: Steel.
 - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
 - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
 - 3. Factory paint external cabinets in manufacturer's standard color.
 - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- F. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
 - 1. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Special Motor Features: Single speed, Premium (TM) efficiency, as defined in Division 23 Section "Common Motor Requirements for HVAC Equipment," and with internal thermal protection and permanent lubrication.
 - 3. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - 4. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- G. Type of Gas: Natural.
- H. Heat Exchanger:
 - 1. Primary: Aluminized steel.
- I. Burner:
 - 1. Gas Valve: 100 percent safety two-stage main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
 - 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- J. Gas-Burner Safety Controls:
 - 1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
 - 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
 - 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- K. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- L. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic light with viewport.
- M. Accessories:
 - 1. Combination Combustion-Air Intake and Vent: PVC plastic fitting to combine combustion-air inlet and vent through roof.
 - 2. CPVC Plastic Vent Materials.
 - a. CPVC Plastic Pipe: Schedule 40, complying with ASTM F 441/F 441M.
 - b. CPVC Plastic Fittings: Schedule 40, complying with ASTM F 438, socket type.
 - c. CPVC Solvent Cement: ASTM F 493.

- 1) Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. PVC Plastic Vent Materials:
- a. PVC Plastic Pipe: Schedule 40, complying with ASTM D 1785.
 - b. PVC Plastic Fittings: Schedule 40, complying with ASTM D 2466, socket type.
 - c. PVC Solvent Cement: ASTM D 2564.
 - 1) Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2) Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- N. Capacities and Characteristics:
1. See plans for capacities.

2.2 AIR FILTERS

- A. Disposable Filters: 1-inch- (25-mm-) thick fiberglass media with ASHRAE 52.2 MERV rating of 13 or higher in sheet metal frame.

2.3 REFRIGERATION COMPONENTS

- A. General Refrigeration Component Requirements:
1. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
 2. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- B. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet
- C. complying with ASHRAE 62.1-2004.
1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.
- D. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I
- E. Air-Cooled, Compressor-Condenser Unit:
1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 2. Compressor: Hermetically sealed reciprocating or scroll type.
 - a. Crankcase heater.
 - b. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - c. Two-speed compressor motors shall have manual-reset high-pressure switch and automatic-reset low-pressure switch.

- d. Refrigerant: R-407C or R-410A.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Mounting Base: Polyethylene.

PART 3 EXECUTION

3.1 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 at mounting height of 60 inches (1500 mm) above floor.
- E. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.
- F. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

3.2 CONNECTIONS

- A. Gas piping installation requirements are specified in Division 23 Section "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Water piping installation requirements are specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect water piping with union and ball valve.
- 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.
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - c. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

4. Slope pipe vent back to furnace or to outside terminal.
- E. Connect ducts to furnace with flexible connector. Comply with requirements in Division 23 Section "Air Duct Accessories."
- F. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.
 1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
 2. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- G. Complete installation and startup checks and start units according to manufacturer's written instructions.
- H. Verify proper operation of capacity control device.
- I. Adjust airflow and initial temperature and humidity set points.
- J. 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.
- K. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- L. Install new filters in each furnace within 14 days after Substantial Completion.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Perform electrical test and visual and mechanical inspection.
 2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
 4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

END OF SECTION

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SECTION 23 5533 - FUEL-FIRED UNIT HEATERS**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes gas-fired unit heaters.

1.2 SUBMITTALS

- A. Product Data: For each type of fuel-fired unit heater indicated. Include rated capacities, operating characteristics, and accessories.
- B. QUALITY ASSURANCE
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of fuel-fired unit heater that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
 - 1. Product data
 - 2. Product certificates
 - 3. Wiring Diagrams

PART 2 PRODUCTS**2.1 GAS-FIRED UNIT HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lennox Industries, Inc.
 - 2. Modine Manufacturing Company.
 - 3. Reznor/Thomas & Betts Corporation.
 - 4. Sterling HVAC Products; Div. of Mestek Technology Inc.
- B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- D. Type of Venting: Power vented, sealed combustion.
- E. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Unit Fan: Propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.

- I. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
 - 1. Gas Control Valve: Single stage.
 - 2. Ignition: Electronically controlled electric spark with flame sensor.
 - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
 - 4. Vent Flow Verification: Differential pressure switch to verify open vent.
 - 5. 24V Control transformer.
 - 6. High Limit: Thermal switch or fuse to stop burner.
- J. Discharge Louvers: Independently adjustable horizontal blades.
- K. Accessories:
 - 1. Four-point suspension kit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.
- B. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- C. Install piping adjacent to fuel-fired unit heater to allow service and maintenance.
- D. Gas Piping: Comply with Division 22 Section "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- E. Vent Connections: Single wall galvanized steel with wall sleeve.
- F. Electrical Connections: Comply with applicable requirements in Division 26 Sections.
 - 1. Install electrical devices furnished with heaters but not specified to be factory mounted.
- G. Adjust initial temperature set points.
- H. Adjust burner and other unit components for optimum heating performance and efficiency.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 26 0010
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DIVISION 26 – ELECTRICAL

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END OF SECTION

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SECTION 26 0051 - ELECTRICAL RELATED WORK**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this Section.
- B. This Section is a Division 26 Basic Materials and Methods Section and is part of each Division 26 section making reference to electrical related work specified herein.

1.2 DESCRIPTION OF WORK

- A. The work to be done under this Specification and the accompanying drawings includes the furnishing of labor, materials, equipment and services necessary for the proper completion of electrical work. In general, this consists of wiring for light and power, installation of raceways for miscellaneous electrical systems and installation of lighting fixtures and other equipment hereinafter specified. Electrical work shall be complete with wiring, conduits, fittings, equipment and connections as specified or required.
- B. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as releasing the contractor from furnishing such parts.
- C. Types of electrical related work specified in this section include the following:
 - 1. Access to electrical work:
 - a. Access doors in walls, ceilings, and floors
 - b. Removable cover plates in walls, ceiling, and floors
 - 2. Excavating for electrical work:
 - a. Underground electrical wiring
 - b. Area lighting
 - 3. Concrete for electrical work:
 - a. Lean concrete backfill to support electrical work
 - b. Encasement of electrical work
 - c. Electrical equipment foundations and mounting pads
 - d. Rough grouting in and around electrical work
 - e. Patching concrete which has been cut to accommodate electrical work.
 - 4. Painting of electrical work:
 - a. Where specifically noted to be painted.
- D. Quality control testing for concrete work is required as work of this section.

1.3 FEES, PERMITS, TAXES, AND INSPECTIONS

- A. Regular inspections shall be requested by the contractor as required by regulations. Charges for the inspections by regulating agencies of installations or plans and specifications shall be paid by the contractor.
- B. All permits, inspections and licenses shall be secured and paid for before actual work is started.
- C. The contractor, after completion of work, shall furnish to the Owner a Certificate of Final Inspection and approval from the inspection bureau having jurisdiction.
- D. State and Local Sales Tax. The Electrical Contractor shall include all state and local sales tax in the bid. The contractor shall maintain accurate records of all taxes and furnish such records to the Owner upon request.

1.4 QUALITY ASSURANCE

- A. Manufacturers. Firms regularly engaged in manufacture of products for electrical work of sizes, types, ratings, and materials required, whose products have been in satisfactory use in similar service.
- B. Installer's qualifications. Firm with successful installation experience on projects with electrical related work similar to that required for this project.
- C. Access units fire-resistance ratings. Where fire-resistance ratings are indicated for construction penetrated by access units, provide UL-listed and labeled units, except for units which are smaller than minimum size requiring ratings, as recognized by governing authority. Concrete work codes and standards. Comply with governing regulations.
- D. Concrete work codes and standards. Comply with governing regulations.
- E. Codes and Standards:
 - 1. Contractor shall comply with all current ordinances, laws, regulations and codes applicable to the work involved. This does not relieve the contractor from furnishing and installing work shown or specified which may be beyond the requirements of such ordinances, laws, regulations and codes.
 - 2. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the Contract Documents, the most stringent shall govern. The contractor shall promptly notify the Engineer in writing of such difference.
 - 3. Non-Compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.
 - 4. Contractor shall initiate, maintain, and supervise all safety pre-cautions required for his work including regulations of the Occupational Safety and Health Administration (OSHA).
 - 5. UL Compliance. All equipment and systems specified in Division 26 shall comply with all applicable UL safety standards and have all required UL listings. All systems shall have UL-listed components, as well as a UL listing for the entire system. When a UL listing for the system is not available, the system shall be tested by an independent laboratory.

1.5 DRAWINGS

- A. The drawings are to scale as noted but the contractor shall refer to Architectural and structural Drawings for exact location of partitions, walls, beams, shafts, equipment, etc. Prior to rough-in, the contractor shall verify with Architect/Engineer exact location of all electrical devices, lights, poles, etc.
- B. Each trade shall avail himself of drawings and specifications of all other trades and make an effort to coordinate his work with all other trades.
- C. The contractor, before roughing-in facilities or installation of any equipment, shall consult all drawings, architectural, structural, mechanical, etc. for finishes, locations of ceiling, ceiling types, structural members, pipes, ducts, recessed lighting fixtures, conduits, etc., which may affect the installation. The contractor in installing his equipment shall leave adequate room for the installation of equipment by other contractors or subcontractors where space is limited.
 - 1. Consideration has been given to such condition of limited space in the preparation of the drawings and the locations and dimensions of equipment have been selected accordingly. The contractor shall be warned that in certain instances, space may be limited to the extent that there may be only one arrangement of equipment or facilities which will allow

installation of same.

2. Where connections are made to equipment furnished by others the contractor shall obtain exact location of connection from persons furnishing that equipment. The contractor shall confirm all voltage and wiring requirements prior to installation.
3. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies with no change in contract cost.
4. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.
5. Where a disagreement exists in the plans and specifications, the item or arrangement of better quality, greater quantity or higher cost, shall be included.

1.6 SYMBOLS AND ABBREVIATIONS

- A. Refer to Symbols and Abbreviations listed on drawings. Other symbols are in common usage but if uncertainty exists regarding plan symbols or abbreviations they shall be brought to the attention of the Engineer for clarification.
- B. Where the phrase starts "Provide----," "provide" shall be construed to mean the same as "Furnish and install-----".

1.7 PRIOR APPROVALS

- A. Prior Approvals. The acceptance of materials and equipment shall be based on the following conditions:
 1. The contractor shall adhere rigidly to the specifications and shall use exact equipment specified or an approved substitution. Where the words "or equal" are used in the specifications, other manufacturers will be considered for acceptance as substitutions; however, such requests must be submitted by a bidding contractor for review prior to bidding. If the contractor desires tentative acceptance of a brand of merchandise not specified, sufficient data shall be submitted to the Engineer for appraisal 240 hours before the time set for bids to be received. If any manufacturer or brands other than those specified, are acceptable to the Engineer, the Engineer will indicate before bids are received; however, such acceptance must still be obtained as described in the following. Equipment which is not specified, or is not approved by addendum will not be considered.

1.8 PROJECT CONDITIONS

- A. Existing utilities. Locate and protect existing utilities and other underground work in manner which will ensure that no damage or service interruption will result from excavating and backfilling. Do not install electrical work to be above existing piping or be in the way of future excavation to existing piping. Where new electrical work must cross existing piping, cross at right angles, do not run parallel with piping.
- B. Protect property from damage which might result from excavating and back-filling.
- C. Protect persons from injury at excavations, by barricades, warnings, and illumination.
- D. Coordinate excavation with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.
- E. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavation from freezing and frost action. Do not install electrical work on frozen excavation bases or sub-bases.

1.9 COMMISSIONING

- A. Division 26 will be responsible to carry out the commissioning requirements specified in Section 260918 and 260923.

PART 2 PRODUCTS

2.1 ACCESS TO ELECTRICAL WORK

- A. Access doors:
 - 1. General: Where floors, walls and ceilings must be penetrated for access to electrical work, provide types of access doors indicated, including floor doors if any. Furnish sizes indicated or, where not otherwise indicated, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.
 - 2. Access Door Construction: Except as otherwise indicated, fabricated wall/ceiling door units of welded steel construction with welds ground smooth; 16-gauge frames and 14-gauge flush panel doors; 175 swing with concealed spring hinges; flush screw-driver-operated cam locks; factory-applied rust-inhibitive prime-coat paint finish.
- B. Removable access plates. Where switches, control devices, pull boxes and similar elements of electrical work are located within or behind walls, ceiling or floor construction of finishes, or below grade, and are not (cannot be) provided with integral removable access plates as specified in other Division 26 sections, provide removable access plates of types and sizes needed for access requirements, as indicated. Provide manufacturer's complete units with anchorages, fasteners and standard factory-applied finishes.

2.2 EXCAVATING FOR ELECTRICAL WORK

- A. Soil (backfill) materials definition: Satisfactory soil materials free of clay, rock, or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

2.3 PAINT

- A. Material quality. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
 - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
- B. Color pigments. Pure, non-fading applicable types to suit substrates and service indicated.
 - 1. Lead content in pigment, NOT ALLOWED.

PART 3 EXECUTION

3.1 ACCESS TO ELECTRICAL WORK

- A. Locate each removable access unit accurately in relation to electrical work requiring access.
- B. Provide adequate temporary support or attachment to framing of form-work, that units will not be dislocated during construction of substrates.

3.2 EXCAVATING FOR ELECTRICAL WORK

- A. General. Do not excavate for electrical work until the work is ready to proceed without delay so that total time lapse from excavation to completion of backfilling will be minimized.
- B. Excavate with vertical-sided excavations to greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property.
- C. Excavation for trenches. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Minimum width shall be 6"
 - 1. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of sand or gravel prior to installation of pipe.
 - 2. Hand excavate bottom cut to accurate elevations and grades, and support pipe or conduit on undisturbed soil or compacted bed.
 - 3. Grade bottoms of trenches as indicated, notching under conduit couplings to provide solid bearing for entire body of conduit.
- D. Store excavated material (temporarily) near excavation, in manner which will not interfere with or damage excavation or other work.
 - 1. Retain excavated material which complies with requirements for backfill material.
 - 2. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

3.3 BACKFILLING

- A. General. Except as otherwise indicated, backfill with properly qualified backfill material.
- B. Inside building walls the electrical contractor shall backfill around underground lines and to top of conduit, pipe or duct to stabilize location and elevation. Balance of backfill and compaction shall be performed by the general contractor.
- C. Outside building walls all backfill and compaction shall be performed by the electrical contractor.
- D. After underground lines have been inspected and prior to backfilling, forms shall be removed and the excavation shall be cleaned of all trash and debris.
- E. Backfill with finely-graded sub-base material to 6" above wrapped, coated and plastic materials.
- F. Condition backfill material by either drying or adding water uniformly. To whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.
- G. Backfill simultaneously on opposite sides of electrical work, and compact simultaneously; do not dislocate the work from installed positions.
- H. Backfill excavations in 8" high courses of backfill material, uniformly compacted.
- I. Backfill to elevations matching adjacent grades, at time of backfilling excavations for electrical work.
- J. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
 - 1. Concrete is specified in Division 3.
 - 2. Do not backfill trenches until inspections have been made and backfilling authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of conduit/pipe systems.
- K. All buried conduits shall be at least 24" below finished grade.

3.4 PAINTING ELECTRICAL WORK

A. Surface Preparation:

1. General. Clean surface before applying paint products. Remove oil and grease prior to mechanical cleaning. Comply with paint products manufacturer's instructions for surface cleaning and preparation. Remove surface-applied accessories which are not to be painted, and reinstall after completion of painting. Protect non-removable items not to be painted, by covering with paper or plastic film.
2. Ferrous metal surfaces. Remove mill scale and loose rust on surfaces which are not zinc-coated or shop/factory prime coated. Each metal edge shall be filed or ground to eliminate sharp edges.
 - a. Clean shop-applied prime coats on metal surfaces, and repair (touchup) prime coats wherever abraded or otherwise damaged, prior to application of paint system.
3. Zinc-coated surfaces. Clean with non-petroleum based solvent. Wash with copper sulfate solution and flush with water, unless surface has been pretreated, or unless treatment is not recommended by manufacturer of prime coat.

3.5 PAINT SYSTEM APPLICATION

- A. Mixing. Comply with manufacturer's recommendations for mixing or stirring paint products immediately before application.
- B. General application requirements. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate, for type of material being applied, and for ambient conditions. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, or until paint film is of uniform finish, color and appearance.
 1. Apply paint at edges, corners, joints, welds, and exposed fasteners in manner which will ensure a dry-film thickness equal to that of flat surfaces. Allow sufficient time between successive coats for proper drying (comply with manufacturer's drying instructions).
 2. Number of coats. The number indicated is minimum number; apply as many coats as are necessary to comply with dry-film thickness requirements. Minimum thickness 0.002".
 3. Coating thickness. Apply uniform coats to produce dry-film thickness indicated or, if not otherwise indicated, apply paint without thinning in application thickness recommended by manufacturer for each coat.
 4. Smooth finishes. Except as otherwise indicated, apply paint in smooth finish without noticeable texture, cloudiness, spotting, holidays, laps, brush marks, runs, sags, ripples, ropiness, and other surface imperfections.

3.6 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

- A. COMPLY WITH NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

- F. Contractor shall provide rough-in for and connect to the following equipment furnished by others. Equipment will be provided by other contractors or owner. Secure rough-in information, connection requirements, and templates from equipment supplier. Verify all equipment voltage and power requirements:
1. Plumbing and HVAC equipment.
 2. Electric motors.
 3. Fire protection sprinkler system alarm switches.
 4. Building Alarm system.
 5. Security system.
 6. Video Surveillance system.
 7. AV Systems

END OF SECTION

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SECTION 26 0053 - CONSTRUCTION LIGHT AND POWER**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this Section.
- B. This Section is a Division 26 Basic Materials and Methods Section and is part of each Division 26 section making reference to construction light and power specified herein.

1.2 DESCRIPTION OF WORK

- A. Work included:
 - 1. The Electrical Contractor shall furnish, install, and maintain lighting and receptacle outlets in accordance with the following:
 - a. Temporary lighting shall be provided at not less than ½ watt per sq ft with not less than one light outlet per room or space. Lamp outlets shall be lamped with 200 watt inside frosted lamps. See temporary lighting plans for minimum requirements.
 - b. Provide receptacles located so that no location within the building is more than 75' from a receptacle. Electrical Contractor shall apportion the lighting and receptacle outlets throughout each floor or area in an arrangement acceptable to the Engineer and other trades.

PART 2 PRODUCTS**2.1 MATERIAL AND COMPONENTS**

- A. Materials for the construction light and power system need not be new and need not conform to the provisions found elsewhere in these specifications relating to materials for the permanent installation. However, materials shall be in good condition and of quality to assure adequate operation and safety of use and shall have the listed approval of Underwriters Laboratories, Inc. where applicable. Materials shall comply with other provisions of this subsection, where applicable.
- B. Temporary receptacles, except where noted otherwise, shall be GFCI 20 ampere, 120 volt, duplex grounding type and shall be installed in suitable outlet boxes with plates.
- C. Temporary lights shall be provided to meet safety requirements and to provide sufficient illumination for the tasks involved.
- D. Temporary conductors, where open wiring is permitted shall be copper or aluminum and, except for grounding conductors, shall be insulated. Insulation for phase conductors shall be rated for the circuit voltage, and insulation of jacketing shall be suitable for the conditions to be encountered. Branch circuit conductors shall be copper. Sizes of branch circuit conductors shall be No. 12 AWG minimum size, except that No. 10 AWG shall be used where length of branch circuit exceeds 100'. Splices of temporary conductors shall be soldered or shall utilize approved type of mechanical connectors, and splices shall be insulated by taping or other approved methods.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Installation of the system shall comply with requirements of NEC 527, OSHA, NECA 200-2010, applicable codes and ordinances as they relate to such temporary wiring.
- B. Except as otherwise provided herein, completed portions of the permanent installation or materials for use in the permanent installation shall not be used in the temporary installation without specific permission of the Engineer.
- C. Temporary electrical services, circuits in excess of 600 volt between phase conductors, extensions of circuits accessible from streets, sidewalks or other thoroughfares of public access, and extensions into occupied portions of buildings shall be installed in accordance with applicable codes relating to permanent work. Other circuits may be installed as open wiring with insulated conductors placed and adequately supported so as not to be readily accessible to unqualified persons. Installed raceways for the permanent installation may be used for installation of temporary wiring.
- D. Grounding shall comply with applicable codes. Grounding terminals of receptacles and non-current carrying metal parts of equipment of the temporary light and power system shall be connected to the common grounding conductor at the service through metallic conduits or through grounding conductors installed with circuit conductors. The permanent grounding system may be utilized for the temporary system.
- E. Overload protection for circuits and equipment of the temporary light and power system shall comply with applicable codes.
- F. Ground fault protection for personnel shall be provided. All 15, 20 and 30 ampere 120 volt receptacles shall have ground fault circuit interrupter protection. All other receptacles shall have either ground fault circuit interrupter protection or comply with the "assured equipment grounding conductor" program.

3.2 ENERGY COSTS

- A. Costs of Energy for Construction Light and Power System will be paid by the General Contractor.

END OF SECTION

SECTION 26 0505 - SELECTIVE DEMOLITION FOR ELECTRICAL**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Electrical demolition.

PART 2 PRODUCTS**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Architect before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
- E. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Metal-clad cable.
- D. Wiring connectors.
- E. Electrical tape.
- F. Wire pulling lubricant.
- G. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable.
- F. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC).
- G. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- I. NFPA 70 - National Electrical Code.
- J. UL 44 - Thermoset-Insulated Wires and Cables.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables.
- L. UL 486A-486B - Wire Connectors.
- M. UL 486C - Splicing Wire Connectors.
- N. UL 486D - Sealed Wire Connector Systems.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- P. UL 1569 - Metal-Clad Cables.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Metal-clad cable is permitted only as follows:
 1. Where not otherwise restricted, may be used:
 - a. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
 - b. Do not install metal-clad cable in mechanical / electrical rooms.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- I. Conductor Material:
 1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL"

indicate aluminum.

- a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
 - 1) Services: Copper conductors unless aluminum is allowed by utility..
 - 2) Feeders: Copper conductors unless listed below.
 - b. Substitution of aluminum conductors for copper is permitted for panelboard feeder conductor sizes 1/0 AWG and larger. Aluminum conductors shall not be permitted for connection to mechanical equipment.
 - c. Where aluminum conductors are substituted for copper, comply with the following:
 - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
 - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
 - 3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
 - 4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- J. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 2. Control Circuits: 14 AWG.
- K. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - b. Equipment Ground, All Systems: Green.
 - c. Travelers for 3-Way and 4-Way Switching: Pink.
 - d. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:

1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 12 AWG and Smaller: Solid.
 - b. Size 10 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.4 METAL-CLAD CABLE

- A. Manufacturers:
 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 2. Encore Wire Corporation: www.encorewire.com/#sle.
 3. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 1. Size 10 AWG and Smaller: Solid.
 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor where indicated or required.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Steel, interlocked tape.

2.5 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
 3. Connectors for Aluminum Conductors: Use compression connectors.
- C. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Aluminum Conductors: Use compression connectors for all connections.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.6 WIRING ACCESSORIES

- A. Electrical Tape:
1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 - 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 - 6. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. Install aluminum conductors in accordance with NECA 104.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- I. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 6 inches of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- Q. Identify conductors and cables in accordance with Section 26 0553.
- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Sect.
- S. Install firestopping to preserve fire resistance rating of partitions and other elements.
- T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

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SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- C. NFPA 70 - National Electrical Code.
- D. UL 467 - Grounding and Bonding Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS**2.1 GROUNDING AND BONDING REQUIREMENTS**

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding Electrode System:
1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 3. Metal Building or Structure Frame:
 - a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 5. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 6. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- E. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with

- NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 8. Provide bonding for interior metal air ducts.
 9. Provide bonding for metal building frame where not used as a grounding electrode.
- F. Communications Systems Grounding and Bonding:
1. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.
 3. Holes for Connections: As indicated or as required for connections to be made.
- E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.13.

- E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

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SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.2 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- D. MFMA-4 - Metal Framing Standards Publication.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- F. NFPA 70 - National Electrical Code.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS**2.1 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.

2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch diameter.
 - c. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - d. Outlet Boxes: 1/4 inch diameter.
- F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.
 8. Plastic and lead anchors are not permitted.
 9. Hammer-driven anchors and fasteners are not permitted.
 10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

- a. Comply with MFMA-4.
- b. Channel Material: Use galvanized steel.
- c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.
- K. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

26 0529

Hangers and Supports for Electrical
Systems

END OF SECTION

SECTION 26 0533.13 - CONDUIT FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit fittings.
- I. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.
- E. Section 26 0533.16 - Boxes for Electrical Systems.
- F. Section 26 0533.16 - Boxes for Electrical Systems.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 31 2316 - Excavation.
- I. Section 31 2323 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
- K. NFPA 70 - National Electrical Code.

- L. UL 1 - Flexible Metal Conduit.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel.
- N. UL 360 - Liquid-Tight Flexible Steel Conduit.
- O. UL 514B - Conduit, Tubing, and Cable Fittings.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- Q. UL 797 - Electrical Metallic Tubing-Steel.
- R. UL 1242 - Electrical Intermediate Metal Conduit-Steel.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.

4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 6. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use rigid PVC conduit.
 2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use rigid PVC conduit.
 3. Within Concrete Walls Above Ground: Use rigid PVC conduit.
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), or MC Cable.
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), or MC Cable.
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit. (RNC) is NOT allowed.
- L. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
1. Maximum Length: 6 feet.
- M. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 3. Maximum Length: 6 feet unless otherwise indicated.
 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.2 CONDUIT REQUIREMENTS

- A. Electrical Service Conduits: Also comply with Section 26 2100.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 1/2 inch (16 mm) trade size.
 2. Underground, Interior: 3/4 inch (21 mm) trade size.
 3. Underground, Exterior: 1 inch (27 mm) trade size.

- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- C. PVC-Coated Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.6 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.8 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.

4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 9. Route conduits above water and drain piping where possible.
- H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- K. Underground Installation:
1. Provide trenching and backfilling in accordance with Sections 31 2316 and 31 2316.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length for service entrance where not concrete-encased.
- L. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Secure conduits to prevent floating or movement during pouring of concrete.
- M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- N. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- P. Provide grounding and bonding in accordance with Section 26 0526.

3.2 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.3 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

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SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.
- D. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.
- G. SCTE 77 - Specification for Underground Enclosure Integrity.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- J. UL 508A - Industrial Control Panels.
- K. UL 514A - Metallic Outlet Boxes.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. Wall Plates: Comply with Section 26 2726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:

3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Floor Boxes:
 1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Use cast iron or epoxy coated steel floor boxes within slab on grade.
 3. Use sheet-steel or cast iron floor boxes within slab above grade.
 4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
- E. Underground Boxes/Enclosures:
 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As indicated on drawings.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 4. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 2. Unless dimensioned, box locations indicated are approximate.
 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.

4. Locate boxes so that wall plates do not span different building finishes.
 5. Locate boxes so that wall plates do not cross masonry joints.
 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
- G. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- H. Install boxes plumb and level.
- I. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- J. Install boxes as required to preserve insulation integrity.
- K. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- L. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 0526.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

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SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 09 9113 - Exterior Painting.
- B. Section 09 9123 - Interior Painting.
- C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace.
- E. UL 969 - Marking and Labeling Systems.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS**2.1 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

- 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Enclosed switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - c. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify load(s) and associated circuits controlled. Include location.
 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.
 3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
 4. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 9123 and 09 9113.
 5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Elevator control panels.
 6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. Within boxes when more than one circuit is present.
 - b. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 4. Use underground warning tape to identify direct buried cables.
- C. Identification for Raceways:
1. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 3. Use underground warning tape to identify underground raceways.
- D. Identification for Boxes:
1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 3. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend:
 - a. Equipment designation or other approved description.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 5. Color:
 - a. Normal Power System: White text on black background.

2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
- D. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
- E. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Legend: Type of service, continuously repeated over full length of tape.

2.6 FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.7 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

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SECTION 26 0918 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Networked switching controls.
- B. Programmable switching controls.
- C. Remote control switching relays.
- D. Power supplies.
- E. Relay cabinets.
- F. Room Controllers and Plug-Load Controllers
- G. Commissioning

1.2 RELATED REQUIREMENTS

- A. Section 26 0533.13 - Conduit for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data showing dimensions and ratings for components.
- C. Shop Drawings: Indicate wiring diagrams of system, showing interface with branch circuit wiring.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual locations of components and record circuiting and switching arrangements.
 - 1. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to owner, copies placed inside the door of each relay panel.
- F. Maintenance Data: Include replacement parts numbers.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acuity Brands, Inc. nLight.
- B. Leviton Mfg. Company Inc.
- C. WattStopper, a Legrand Group brand
- D. Cooper Controls, Inc.
- E. Lutron Electronics Company, Inc.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

- A. System General: Provide system complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.
- B. Equipment Required: Lighting Control system as defined under this section covers the following equipment.
 - 1. Lighting Relay Panel
 - 2. Digital Network Clock
 - 3. Lighting Network Controller
 - 4. Building Automation System Interface
 - 5. Digital Room Controllers
 - 6. Digital Wall Switches and Dimmer
 - 7. Digital Occupancy Sensors
 - 8. Digital Daylighting Sensors
 - 9. Programming Device
 - 10. Lighting Network Cabling and Power Limited Wire

2.3 LIGHTING RELAY PANELS

- A. Hardware: Provide lighting relay panels in the locations and capacities as indicated on the Drawing and schedules. Each panel shall be of modular construction and consist of the following components:
 - 1. Enclosure/Tub shall be NEMA 1, sized to accept an interior assembly as indicated on plans.
 - 2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. Provide hinged lockable front cover.
 - 3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. Interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. Interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. Panel interiors shall include the following features:
 - a. Removable, plug-in terminal blocks with connections for all low voltage terminations.
 - b. Individual terminal block, override pushbutton, and LED status light for each relay.
 - c. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
 - 4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
 - a. Electrical:

- 1) 30 amp ballast at 277V
- 2) 20amp tungsten at 120V
- 3) 1.5 HP motor at 120V
- 4) 14,000 amp short circuit current rating (SCCR) at 277V
- 5) Relays shall be specifically UL 20 listed for control of plug-loads
- b. Mechanical:
 - 1) Replaceable, 1/2 inch KO mounting with removable Class 2 wire harness.
 - 2) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - 3) Dual line and load terminals each support two #14 - #12 solid or stranded conductors.
 - 4) Tested to 300,000 mechanical on/off cycles.
5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
7. Distributed only systems will not be allowed where relay panel(s) are shown on plans. Groups relays are to be installed in single enclosure.
8. Relay panel shall allow for 125% of loads shown on plans.

2.4 DIGITAL NETWORK CLOCK

- A. Integral system clock shall provide scheduling capabilities.
 1. Scheduler component shall be integral to relay panel or a separate component where relay panel is not required.
 2. Digital network clock shall be able to issue system wide automation commands. Clock shall provide capability for up to 254 independent schedule events for each system wide channel groups.
 3. Clock capability shall support the time-based energy saving requirements of applicable local energy codes.
 4. Clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
 5. Clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
 - a. Scheduled ON / OFF
 - b. Manual ON / Scheduled OFF
 - c. Astro ON / OFF (or Photo ON / OFF)
 - d. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
 6. Clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
 7. System shall allow end user to adjust scheduling locally without the need of remote access from the factory.
- B. Digital Network Clock shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices.

Digital communications shall be RS485 MS/TP-based using the BACnet protocol.

1. Panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 - 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
2. Panel shall support MS/TP MAC addresses in the range of 0 - 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
3. Lighting control relays shall be controllable as binary output objects in the instance range of 1 - 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
4. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 - 64.

2.5 LIGHTING NETWORK CONTROLLER

- A. The lighting system shall include at least one Lighting Network Controller to manage lighting network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).
- B. Each Lighting Network Controller shall have integral support for at least (1) local room network(s).
- C. Operational features of the Lighting Network Controller shall include the following:
 1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 2. Easy to learn and use graphical user interface, compatible with standard internet browser. The Segment Manager shall not require installation of any lighting control software on an end-user PC.
 3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Lighting Network Controller shall provide two main sets of interface screens - those used to initially configure the unit (referred to as the config screens), and a those used to allow users to dynamic monitor the performance of their system, and provide a centralized scheduling interface. Capabilities using the Config Screens shall include:
 - a. Automatic discovery of networked devices and relay panels on the lighting control network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
 - b. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
 - c. Ability to view and modify networked device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
 5. Capabilities using the Lighting Network Controller's Dashboard Screens shall include:
 - a. Ability to set up schedules for local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms with either on/off or normal hours/after hours set controlled zones or areas to either a normal hours or after hours mode of operation. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as astro On or astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled

- events by day, week or month.
- b. Ability to provide a simple time vs. power graph based on information stored in each Segement Manager's memory (typically two to three days' data).
- 6. Lighting Network Controller shall allow access and control of the overall system database.
- D. All local room networks (room controllers) shown on plan to be operate on schedules shall be networked to allow scheduling and remote commissioning ability.

2.6 DIGITAL ROOM CONTROLLERS AND PLUG-LOAD CONTROLLERS

- A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard applications. Control units include the following features
 - 1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - 2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
 - 3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
 - 4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 - 5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
 - 6. Each load be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
 - 7. UL 2043 plenum rated
 - 8. Manual override and LED indication for each load
 - 9. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
 - 10. Dimming Room Controllers shall share the following features:
 - a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
 - b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
 - c. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - 1) Establish preset level for each load from 0-100 percent

- 2) Set high and low trim for each load
 - d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
 - g. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
- B. On/Off Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
 2. 150 mA switching power supply.
 3. Local network ports with integral strain relief and dust cover.
- C. On/Off/0-10V Dimming Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) capable, 60 Hz. Rated for 20A total load.
 2. 250 mA switching power supply
 3. Local network ports with integral strain relief and dust cover.
 4. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.
- D. On/Off/ Forward Phase Dimming Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) rated for 20A total load, with forward phase dimmed loads derating to 16A for some load types
 2. One dimming output per relay
 - a. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads.
- E. Room Controllers in stand-alone rooms are not required to be networked to the Lighting Network Controller.

2.7 DIGITAL WALL SWITCHES AND DIMMERS

- A. Low voltage momentary pushbutton switches in multi-button configurations. Wall switches shall include the following features:
1. Two-way transceiver for use with personal and configuration remote controls.
 2. Configuration LED on each switch that blinks to indicate data transmission.
 3. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level or multi-color LED to indicate status.
 4. Programmable control functionality including:
 - a. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

5. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. Two network ports for connection to local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology local network. No additional configuration shall be required to achieve multi-way switching.
- D. Button function may be reconfigured for individual buttons.
 1. Individual button function may be configured to Toggle, On only or Off only.
 2. Individual scenes may be locked to prevent unauthorized change.
 3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 4. Ramp rate may be adjusted for each dimmer switch.
 5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
- E. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
 1. Manufacturers who cannot meet this requirement are not acceptable.

2.8 DIGITAL OCCUPANCY SENSORS

- A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity, 0-100 percent in 10 percent increments
 - b. Time delay, 1-30 minutes in 1 minute increments
 - c. Test mode, Five second time delay
 - d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 2. Load parameters including Auto/Manual-ON.
 3. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - e. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. One or two network ports for connection to local network.
 5. Two-way transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection

- b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Manual override of controlled loads.
 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- B. Wall and Ceiling Mounted Sensors
1. Dual technology (passive infrared and ultrasonic) digital occupancy sensor.
 2. Provide fixed mount type unless noted otherwise. Provide adjustable pivot type where called out on plan.
- C. Wall Switch Mounted Sensors
1. Dual technology (passive infrared and ultrasonic) digital occupancy sensor with one and two- switch buttons.
 2. Passive Infrared type digital occupancy sensor with one and two switch buttons.
 3. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:
 - a. Button 1
 - 1) Press and release - Turn load on
 - 2) Press and hold - Raise dimming load
 - b. Button 2
 - 1) Press and release - Turn load off
 - 2) Press and hold - Lower dimming load
 4. Low voltage momentary pushbuttons shall include the following features:
 - a. Load/Scene Status LED on each switch button with the following characteristics:
 - 1) Bi-level or multi-color LED to indicate status.
 - b. The following button attributes may be changed or selected using a configuration tool:
 - 1) Individual button function may be configured to Toggle, On only or Off only.
 - 2) Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
- D. Units shall not have any dip switches or potentiometers for field settings
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the local network. No additional configuration will be required.

2.9 DIGITAL DAYLIGHTING SENSORS

- A. Digital daylighting sensors shall work with load controllers and relay panels to provide dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
- B. Interior Digital daylighting sensors shall include the following features:
1. Sensor Type
 - a. Provide Closed Loop type sensors unless specifically noted otherwise.
 - b. Provide Open Loop sensors in ceilings over 15' high.
 - c. Provide Dual loop sensors in skylights.
 2. Sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve.

Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.

3. Sensor light level range shall be from 1-6,000 foot-candles (fc).
 4. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
 5. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
 6. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
 7. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
 8. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
 9. Wall dimmer override control shall allow occupants to reduce or increase lighting levels for a selectable period of time or cycle of occupancy.
 10. Integral transceiver for configuration and/or commissioning with a handheld configuration tool and to transmit detected light level to wireless configuration tool.
 11. Configuration LED status light on device that blinks to indicate data transmission.
 12. Status LED indicates test mode, override mode and load binding.
 13. Recessed switch on device to turn controlled load(s) ON and OFF.
 14. Network port for connection to local network.
 15. Proper accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.
 16. Any load or group of loads in the room can be assigned to a daylighting zone
 17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
 18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
 19. Sensors must have remote calibration capability.
- C. Exterior Digital daylighting sensors shall include the following features:
1. Sensor Type
 - a. Provide Open Loop type sensor.
 2. Provide exterior rated sensors for exterior applications.
 3. Provide I/O device as required for connection to lighting control system.
 4. Sensor light level range shall be from 1-200 foot-candles (fc).
 5. Sensor shall have remote calibration.

2.10 PROGRAMMING DEVICE

- A. Provide a wireless configuration tool to facilitate customization of local networks using two-way infrared or bluetooth communications, and/or PC software that connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:

1. Two-way infrared (IR) or bluetooth communication within a range of approximately 30 feet.
2. Bluetooth based systems shall be configurable via mobile device. A non-cellular bluetooth enabled device shall be furnished to owner and setup to give owner programming ability at project turnover.
3. Proprietary stand-alone devices shall have the following features
 - a. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 - b. Provide minimum of (1) to owner upon project turnover.
4. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify devices by type and serial number.
5. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
6. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
7. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
8. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.

2.11 LIGHTING NETWORK CABLING AND POWER LIMITED WIRE

- A. Local Network: Local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
 1. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
 2. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.
- B. Plenum Cable: Copper conductor, 300 volt insulation rated 60 degrees C, individual conductors twisted together and covered with nonmetallic jacket; suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.12 REMOTE SENSORS

- A. Provide digital occupancy sensors to control relays in locations as shown on the plans. Sensors shall be either passive infrared, ultrasonic, or dual technology as indicated. Sensors shall be either ceiling or wall mounded and connect to the panel using Cat 5e cable with RJ-45 terminations. Digital occupancy sensors shall have the following features:
 1. Setup and calibration shall be digital and precisely repeatable from sensor to sensor.
 2. User interface with pushbuttons and illuminated LCD screen for setup and calibration.
 3. Ladder-free setup and calibration with optional handheld two-way infrared commissioning tool.
 4. Sensitivity, 0 - 100% in 10% increments.
 5. Time delay, 1 - 30 minutes in 1 minute increments.
 6. Test mode with five-second time delay for simplified walk testing.
 7. Design basis is the WattStopper LM series.
 8. Digital occupancy sensors shall be able to control groups and group actions shall be system global such that any digital occupancy sensor can affect the state of relays

present in up to (12) twelve panels networked together.

- B. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- C. Exterior Lighting Sensor:
 - 1. Description: Photodiode lighting sensor in weatherproof housing.
- D. Interior Lighting Sensor:
 - 1. Description: Photodiode lighting sensor suitable for mounting on wall or ceiling and characterized with a dead band to eliminate ON-OFF cycling of relays in response to its own switching action.
 - 2. Sensor must have remote calibration capability.

2.13 RELAY CABINETS

- A. Boxes: Galvanized steel with removable endwalls.
- B. Interior Panel: Metal, suitable for mounting components, matte white.
- C. Fronts: Steel, flush type with concealed trim clamps door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- D. Metal Barriers: Between wiring of different systems and voltages.
- E. Power Terminals: NEMA ICS 4, unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- F. Ground Bus Terminal Block: Bond each connector to enclosure.

2.14 APPLICATION SEQUENCE OF OPERATIONS SUPPORT

- A. The lighting control panel shall support relay behavior parameter configuration of such an extent as to allow digital switch, digital occupancy sensor, digital automatic photocells, and scheduled events to seamlessly implement, at a minimum, the following operational sequences:

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install wiring in the following locations in conduit in accordance with Section 26 0533.13:
 - 1. Exposed along surfaces.
- B. Install relays to be accessible. Allow space for adequate ventilation and circulation of air.
- C. Wall stations at a shared location shall be grouped under a single faceplate.
- D. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

3.2 SUPPORT SERVICES

- A. System Start Up
 - 1. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of the lighting control panels, switches, and occupancy sensors.
- B. Training
 - 1. The technician shall provide training on the lighting control features of the system. Provide a minimum of two hours training. Training may not be on same day be on same day as system training/startup.

3.3 COMMISSIONING

- A. Lighting controls supplier shall be responsible to provide a representative who will perform commissioning services. Provide functional testing and documentation for all lighting control devices and control systems to meet the requirements of applicable energy code.
- B. All timing shall meet code minimum requirements and be adjusted as requested by owner/engineer.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of system.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Occupancy sensors.
- B. In-wall interval timers.
- C. Commissioning

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
- F. Section 26 5100 - Interior Lighting.
- G. Section 26 5600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- C. NFPA 70 - National Electrical Code.
- D. UL 916 - Energy Management Equipment.
- E. UL 917 - Clock-Operated Switches.
- F. UL 1472 - Solid-State Dimming Controls.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- D. Field Quality Control Reports.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.
- C. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.2 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Leviton Mfg Company, Inc.
 - 2. Lutron Electronics Company, Inc:
 - 3. Sensor Switch Inc:
 - 4. WattStopper:
 - 5. Cooper Controls
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
 - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 - 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 - 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 - 7. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with

electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

C. Wall Switch Occupancy Sensors:

1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
 - 1) Manufacturers who cannot meet this requirement are not acceptable.
2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:

1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
 - b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - c. Provide field adjustable dimming preset for occupied state.
 - d. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
 - 1) Manufacturers who cannot meet this requirement are not acceptable.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
 - a. Products:
 - 1) Lutron Maestro 0-10V Dimmer Sensor Series.
 - 2) Equals

E. Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
2. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
3. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
- F. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on drawings.

2.3 IN-WALL INTERVAL TIMERS

- A. Digital Electronic In-Wall Interval Timers:
1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
 2. Program Capability: Designed to turn load off at end of preset time interval.
 3. Time Interval: Field selectable range of presets available up to 12 hours.
 4. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.
 5. Provide power outage backup to retain programming and maintain clock.
 6. Manual override: Capable of both turning load off and resetting timer to original preset time interval.
 7. Switch Configuration: Suitable for use in either SPST or 3-way application.
 8. Contact Ratings: As required to control the load indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
- G. Provide required supports in accordance with Section 26 0529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Occupancy Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- J. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.3 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 COMMISSIONING

- A. Lighting controls supplier shall be responsible to provide a representative who will perform commissioning services. Provide functional testing and documentation for all lighting control devices and control systems to meet the requirements of applicable energy code.
- B. All timing shall meet code minimum requirements and be adjusted as requested by owner.
- C. Upon completion provide documentation to authority having jurisdiction.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.
 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.

4. Location: At project site.

END OF SECTION

SECTION 26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2416 - Panelboards: Service entrance equipment.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NFPA 70 - National Electrical Code.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Contractor.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 QUALITY ASSURANCE

- A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).
2. NFPA 70 (National Electrical Code).
3. The requirements of the Utility Company.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics:
 1. Service Type: Underground.
 2. Service Voltage: 208Y/120 V, 3 phase, 60 Hz.
- C. Division of Responsibility: As indicated on drawings.
- D. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required protective bollards in accordance with Utility Company requirements.
- E. Provide required support and attachment components in accordance with Section 26 0529.
- F. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- G. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

END OF SECTION

SECTION 26 2416 - PANELBOARDS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- H. NFPA 70 - National Electrical Code.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- K. UL 67 - Panelboards.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- M. UL 869A - Reference Standard for Service Equipment.
- N. UL 943 - Ground-Fault Circuit-Interrupters.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation:
- B. General Electric Company:
- C. Schneider Electric; Square D Products:
- D. Siemens Industry, Inc:
- E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings. Provide as service entrance rated where noted on the drawings.
- B. Conductor Terminations:
 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Aluminum.
 3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

2.5 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), NEMA PB 1.1, NECA 1 (general workmanship), NECA 407 (panelboards), NEMA PB 1.1, NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install panelboards plumb.

- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Install all field-installed branch devices, components, and accessories.
- K. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- L. Provide filler plates to cover unused spaces in panelboards.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.3 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

3.4 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2726 - WIRING DEVICES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.

1.2 RELATED REQUIREMENTS

- A. Section 26 0533.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices.
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications.
- G. NFPA 70 - National Electrical Code.
- H. UL 20 - General-Use Snap Switches.
- I. UL 498 - Attachment Plugs and Receptacles.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.
- K. UL 943 - Ground-Fault Circuit-Interrupters.
- L. UL 1472 - Solid-State Dimming Controls.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell Incorporated:
- B. Leviton Manufacturing Company, Inc:
- C. Lutron Electronics Company, Inc:
- D. Pass & Seymour, a brand of Legrand North America, Inc:
- E. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.2 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.

2.3 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Finished Spaces: Gray with stainless steel wall plate. All cover and device colors shall be approved by the architect during shop drawing review.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate. All cover and device colors shall be approved by the architect during shop drawing review.
- D. Wiring Devices Installed in Wet or Damp Locations: Gray with specified metal weatherproof in-use cover. All cover and device colors shall be approved by the architect during shop drawing review.

2.4 WALL SWITCHES

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- B. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.5 WALL DIMMERS

- A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- B. Control: Slide control type with slide on/off control.
- C. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
 - 1. Magnetic Low-Voltage: 600 VA.
 - 2. Electronic Low-Voltage: 600 VA.
 - 3. LED: 0-10V

2.6 RECEPTACLES

- A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- B. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. USB Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R duplex with integral dual USB receptacles and associated transformer, 3.1A or greater [$<>$].
- C. GFCI Receptacles:
 - 1. GFCI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
- D. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.

2.7 WALL PLATES

- A. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- C. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

- D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.8 FLOOR BOX SERVICE FITTINGS

- A. Description: Service fittings compatible with floor boxes provided under Section 26 0533.16 with components, adapters, and trims required for complete installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.

- L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- N. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on left.
- O. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Inspect each wiring device for damage and defects.
- D. Operate each wall switch with circuit energized to verify proper operation.
- E. Test each receptacle to verify operation and proper polarity.
- F. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

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SECTION 26 2816.13 - ENCLOSED CIRCUIT BREAKERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Enclosed circuit breakers.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- B. NFPA 70 - National Electrical Code.
- C. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- D. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- E. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- F. UL 869A - Reference Standard for Service Equipment.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of circuit breaker upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 4. Include documentation of listed series ratings upon request.

1.5 QUALITY ASSURANCE**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Siemens Industry, Inc:
- B. Eaton Corporation:
- C. General Electric Company:
- D. Schneider Electric; Square D Products:

- E. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
- E. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Provide thermal magnetic circuit breakers unless otherwise indicated.
- H. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
- J. Provide externally operable handle with means for locking in the OFF position.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Provide mechanical lugs unless otherwise indicated.
 - 2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
- E. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION**3.1 EXAMINATION**

- A. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- B. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- B. Install enclosed circuit breakers plumb.
- C. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- D. Provide grounding and bonding in accordance with Section 26 0526.
- E. Identify enclosed circuit breakers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

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SECTION 26 2816.16 - ENCLOSED SWITCHES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- E. NFPA 70 - National Electrical Code.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- H. UL 98 - Enclosed and Dead-Front Switches.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Siemens Industry, Inc:
- B. Eaton Corporation:
- C. General Electric Company:
- D. Schneider Electric; Square D Products:

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Horsepower Rating: Suitable for connected load.
- D. Voltage Rating: Suitable for circuit voltage.
- E. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- F. Provide with switch blade contact position that is visible when the cover is open.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- L. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- E. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 3213 - ENGINE GENERATORS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Packaged engine generator system and associated components and accessories:
 - 1. Engine and engine accessory equipment.
 - 2. Alternator (generator).
 - 3. Generator set control system.
 - 4. Generator set enclosure.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 23 1113 - Facility Fuel-Oil Piping:
 - 1. Diesel fuel piping.
- C. Section 23 5100 - Breechings, Chimneys, and Stacks: Engine exhaust piping.
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 3600 - Transfer Switches.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NECA/EGSA 404 - Standard for Installing Generator Sets.
- C. NEMA MG 1 - Motors and Generators.
- D. NFPA 30 - Flammable and Combustible Liquids Code.
- E. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
- F. NFPA 70 - National Electrical Code.
- G. NFPA 110 - Standard for Emergency and Standby Power Systems.
- H. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.
- I. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries.
- J. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids.
- K. UL 2200 - Stationary Engine Generator Assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - a. Transfer Switches: See Section 26 3600.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
 1. Include generator set sound level test data.
 2. Include characteristic trip curves for overcurrent protective devices upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Evidence of qualifications for installer.
- E. Manufacturer's factory emissions certification.
- F. Source quality control test reports.
- G. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
 1. Certified prototype tests.
 2. Torsional vibration compatibility certification.
 3. NFPA 110 compliance certification.
 4. Certified rated load test at rated power factor.
- H. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- I. Maintenance contracts.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Filter Elements: One of each type, including fuel, oil and air.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
 2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
 3. NFPA 30 (Flammable and Combustible Liquids Code).
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Packaged Engine Generator Set - Other Acceptable Manufacturers:
 - 1. Caterpillar Inc:
 - 2. Cummins Power Generation Inc:
 - 3. Generac Power Systems:
 - 4. Kohler Co:
 - 5. MTU Onsite Energy, a Brand of Rolls-Royce Power Systems
- B. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.2 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. System Description:
 - 1. Application: Emergency/standby.
 - 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
- D. Packaged Engine Generator Set:
 - 1. Type: Diesel (compression ignition).
 - 2. Power Rating: As indicated on drawings, standby.
 - 3. Voltage: As indicated on drawings.
 - 4. Main Line Circuit Breaker:
 - a. Type: Thermal magnetic.
 - b. Trip Rating: As indicated on drawings.
- E. Generator Set General Requirements:
 - 1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
 - 2. Factory-assembled, with components mounted on suitable base.
 - 3. List and label engine generator assembly as complying with UL 2200.

4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
 5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
- F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- G. Starting and Load Acceptance Requirements:
1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
 2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
 4. Maximum Load Step: Supports 100 percent of rated load in one step.
- H. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.
- I. Sound Level Requirements:
1. Do not exceed 75 dBA when measured at 23 feet from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.

2.3 ENGINE AND ENGINE ACCESSORY EQUIPMENT

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
 2. Fuel Storage: Sub-base fuel tank.
 3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
 4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 5. Sub-Base Fuel Tank:
 - a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
 - b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
 - c. Features:
 - 1) Normal atmospheric vent.
 - 2) Emergency pressure relief vent.

- 3) Fuel fill opening with lockable cap.
 - 4) Dedicated electrical conduit stub-up area.
- C. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
 2. Battery(s):
 - a. Battery Type: Lead-acid.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
 4. Battery Charger:
 - a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Recognized as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
 - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
 - f. Provide alarm output contacts as necessary for alarm indications.
- D. Engine Speed Control System (Governor):
1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- E. Engine Lubrication System:
1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
- F. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
 3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.
- G. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

2.4 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
 - 1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 - 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 - 3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.
- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.

2.5 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
 - 1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 - 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
 - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
 - f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
 - 3. Generator Set Status Indications:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).
 - e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure.
 - l. Engine coolant temperature.
 - m. Engine run time.

- n. Generator powering load (position signal from transfer switch).
 - 4. Generator Set Protection and Warning/Shutdown Indications:
 - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (shutdown).
 - 6) Overspeed (shutdown).
 - 7) Low fuel level (warning).
 - 8) Low coolant level (warning/shutdown).
 - 9) Generator control not in automatic mode (warning).
 - 10) High battery voltage (warning).
 - 11) Low cranking voltage (warning).
 - 12) Low battery voltage (warning).
 - 13) Battery charger failure (warning).
 - b. In addition to NFPA 110 requirements, provide the following protections/indications:
 - 1) High AC voltage (shutdown).
 - 2) Low AC voltage (shutdown).
 - 3) High frequency (shutdown).
 - 4) Low frequency (shutdown).
 - 5) Overcurrent (shutdown).
 - c. Provide contacts for local and remote common alarm.
 - d. Provide lamp test function that illuminates all indicator lamps.
 - 5. Other Control Panel Features:
 - a. Event log.
- C. Remote Annunciator:
- 1. Remote Annunciator Mounting: Wall-mounted; Provide surface mounted Annunciator adjacent to ATS.
 - 2. Generator Set Status Indications:
 - a. Generator powering load (via position signal from transfer switch).
 - b. Communication functional.
 - 3. Generator Set Warning/Shutdown Indications:
 - a. Provide audible alarm with silence function.
 - b. Provide lamp test function that illuminates all indicator lamps.

2.6 GENERATOR SET ENCLOSURE

- A. Enclosure Type: Sound attenuating, weather protective.
- B. Enclosure Material: Steel or aluminum.
- C. Hardware Material: Stainless steel.
- D. Color: Manufacturer's standard.
- E. Mounting: Pad.
- F. Access Doors: Lockable, with all locks keyed alike.
- G. Openings: Designed to prevent bird/rodent entry.
- H. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

- I. Sound Attenuating Enclosures: Line enclosure with non-hygroscopic, self-extinguishing sound-attenuating material.

2.7 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
- C. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide proper supports/structure for mounting on roof. Provide suitable vibration isolators[<>], where not factory installed.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- G. Provide diesel fuel piping and venting in accordance with Section 23 1113, where not factory installed.
- H. Provide engine exhaust piping in accordance with Section 23 5100, where not factory installed.
 - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
 - 2. Do not exceed manufacturer's maximum back pressure requirements.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Identify system wiring and components in accordance with Section 26 0553.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- E. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- F. Prepare and start system in accordance with manufacturer's instructions.
- G. Perform acceptance test in accordance with NFPA 110.
- H. Provide field emissions testing where necessary for certification.

3.3 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.4 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
- C. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters.

3.5 MAINTENANCE

- A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION

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SECTION 26 3600 - TRANSFER SWITCHES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
 - 1. Automatic transfer switches.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 14 2400 - Hydraulic Elevators: For interface with transfer switch.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 110 - Standard for Emergency and Standby Power Systems.
- G. UL 1008 - Transfer Switch Equipment.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
 - a. Engine Generators: See Section 26 3213.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Source quality control test reports.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Transfer Switches:
 - 1. ASCO Power Technologies, a brand of Emerson Network Power:
 - 2. Eaton Corporation:
 - 3. General Electric Company:
 - 4. Caterpillar, Inc.
 - 5. Cummins, Inc.
 - 6. Generac Power Systems, Inc.
 - 7. Kohler, Inc.

2.2 TRANSFER SWITCHES

- A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:

1. Utilize open transition transfer unless otherwise indicated or required.
 2. Provide signal before transfer contacts for transfer switches serving elevators.
- D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- E. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).
- F. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
- G. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
- H. Switching Methods:
1. Open Transition:
 - a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
- I. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- J. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 2. Finish: Manufacturer's standard unless otherwise indicated.
- K. Short Circuit Current Rating:
1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.
- L. Automatic Transfer Switches:
1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
 2. Control Functions:
 - a. Automatic mode.
 - b. Test Mode: Simulates failure of primary/normal source.
 - c. Voltage and Frequency Sensing:
 - 1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
 - 2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - 3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - d. Outputs:
 - 1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
 - 2) Auxiliary contacts; one set(s) for each switch position.

- 3) Signal before transfer (load disconnect) contacts; for selective load disconnection prior to transfer.
- e. Adjustable Time Delays:
 - 1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
 - 2) Transfer to alternate/emergency source time delay.
 - 3) Retransfer to primary/normal source time delay.
 - 4) Signal before transfer (load disconnect) contact time delay.
 - 5) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
- f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
- g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
3. Status Indications:
 - a. Connected to alternate/emergency source.
 - b. Connected to primary/normal source.
 - c. Alternate/emergency source available.
4. Automatic Sequence of Operations:
 - a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
 - b. Where applicable, initiate signal before transfer (load disconnect) contacts at programmable time before transfer.
 - c. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
 - d. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
 - e. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

2.3 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install transfer switches in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install transfer switches plumb and level.
- F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Automatic Transfer Switches:
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The control wiring insulation-resistance tests listed as optional are not required.
- D. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.3 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.4 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

END OF SECTION

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SECTION 26 5100 - INTERIOR LIGHTING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Interior luminaires.
- B. Exit signs.
- C. Ballasts and drivers.
- D. Luminaire accessories.

1.2 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- G. NFPA 70 - National Electrical Code.
- H. UL 1598 - Luminaires.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.
- b. Include IES LM-79 test report upon request.
- C. Samples:
 - 1. Provide one sample(s) of each specified or proposed for substitution luminaire upon request.
 - 2. Provide one sample(s) of each product finish illustrating color and texture upon request.
- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Ballasts/Drivers: Two percent of total quantity installed for each type, but not less than one of each type.
- F. In the event a proposed substitution is rejected for any reason, the Contractor shall furnish the specified fixture at no cost to the owner.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.7 WARRANTY

- A. Provide five year minimum manufacturer warranty for all LED fixture components.
- B. Provide five year pro-rata warranty for batteries for emergency lighting units.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. UL Listed.
 - b. Designed for field cutting in accordance with listing.
- J. LED Luminaire Components: UL 8750 recognized or listed as applicable.
- K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.2 EXIT SIGNS

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- C. Self-Powered Exit Signs:
 - 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.3 LED DRIVERS

- A. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to Ten percent minimum relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.4 SSL/LED SOURCES

- A. References to SSL and/or LED sources shall include the entire solid-state lighting system, including circuitry, LEDs, power supplies, drivers, etc.
- B. IESNA LM-79 compliant, latest edition.
- C. IESNA LM-80 compliant, latest edition; 50,000 hours minimum.
- D. CRI and color temperature as scheduled in accordance with ANSI C78.377.
- E. NEMA.SSL-1 compliant for operational characteristics and electrical safety of SSL power supplies and drivers. ANSI/NEMA C82.77 compliant for maximum allowable harmonic

distortion produced by SSL power supplies.

- F. Manufacturer Warranty: Minimum manufacturer warranty shall be five year unless specifically noted otherwise.

2.5 ACCESSORIES

- A. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- B. Provide light fixture enclosures where fixtures are installed in ceilings with continuous insulation to allow separation from the insulation.
 - 1. EZ Barrier EZB-16-24-9 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 1 (general workmanship), and NECA 1 (general workmanship).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
- G. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Install canopies tight to mounting surface.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install accessories furnished with each luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.

- K. Exit Signs:
- L. Remote Ballasts/Drivers: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.
- M. Identify luminaires connected to emergency power system in accordance with Section 26 0553.
- N. LED Tape Lighting Systems: All connections at tape shall be solder tape. Due to connection failure rates quick type connectors are not allowed.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.3 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.4 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.6 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.
- B. Replace any damaged lenses prior to building turnover.

END OF SECTION

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SECTION 26 5600 - EXTERIOR LIGHTING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Exterior luminaires.
- B. Drivers.
- C. Poles and accessories.
- D. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- B. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.
- C. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- G. NFPA 70 - National Electrical Code.
- H. UL 1598 - Luminaires.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 WARRANTY

- A. Provide five year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. Recessed Luminaires:
 1. Ceiling Compatibility: Comply with NEMA LE 4.
 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- I. LED Luminaires:
 1. Components: UL 8750 recognized or listed as applicable.
 2. Tested in accordance with IES LM-79 and IES LM-80.
 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- J. LED Luminaire Components: UL 8750 recognized or listed as applicable.
- K. Exposed Hardware: Stainless steel.

2.2 SSL/LED SOURCES

- A. References to SSL and/or LED sources shall include the entire solid-state lighting system, including circuitry, LEDs, power supplies, drivers, etc.
- B. IESNA LM-79 compliant, latest edition.
- C. IESNA LM-80 compliant, latest edition; 50,000 hours minimum.
- D. CRI and color temperature as scheduled in accordance with ANSI C78.377.
- E. NEMA.SSL-1 compliant for operational characteristics and electrical safety of SSL power supplies and drivers. ANSI/NEMA C82.77 compliant for maximum allowable harmonic distortion produced by SSL power supplies.
- F. Manufacturer Warranty: Minimum manufacturer warranty shall be five year unless specifically noted otherwise.

2.3 POLES

- A. All Poles:
 - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
 - 2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
 - d. Fatigue Design and Vortex Shedding: Nontapered lighting structures shall be designed to resist vortex shedding-induced loads for critical wind velocities less than approximately 65 fps; 45 mph. Except for round tapered poles, for all poles 20 feet in height or higher, provide a factory installed internal vibration dampener designed to resist fatigue caused by vortex shedding induced loads and natural wind gusts in the pole indefinitely without failure. Apply an importance factor of 0.3 for vortex shedding and 0.44 for natural wind gusts.
 - 3. Finish: Match luminaire finish, unless otherwise indicated.
 - 4. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
 - 5. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
 - e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
- B. Metal Poles: Provide ground lug, accessible from handhole.

2.4 ACCESSORIES

- A. Provide light fixture enclosures where fixtures are installed in ceilings with continuous insulation to allow separation from the insulation.
 - 1. EZ Barrier EZB-16-24-9 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing. Provide light fixture enclosure.
- F. Ground Mounted Luminaires
 - 1. Install on concrete base with top 2 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."
- G. Install accessories furnished with each luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.3 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.4 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.6 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

- A.** Section Includes:
 - 1.** Removal and disposal of vegetation and topsoil.
 - 2.** Clearing and grubbing.

1.02 PROTECTION OF EXISTING CONDITIONS

- A.** Provide protection necessary to prevent damage to the existing conditions indicated to remain in place.
- B.** Restore damaged areas to their original condition, as acceptable to the parties having jurisdiction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SITE CLEARING

- A.** Remove vegetation, improvements, or obstructions interfering with the installation of new construction. Remove such items elsewhere on the site or premises as specifically indicated.
- B.** Mark trees to be removed and notify Owner/Architect for review prior to removal.
- C.** Clear the site of trees, stumps, roots, shrubs, or other vegetation, except for those indicated to remain standing.
- D.** Completely remove stumps, roots, and other debris protruding through the ground surface or to the depths indicated. Stumps located in areas to be landscaped can be ground down to 18" below finished grade.

END OF SECTION

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SECTION 31 20 00

EXCAVATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Excavation.

1.02 REFERENCES

- A. ASTM D2487, Standard Test Method for Classification of Soils for Engineering Purposes.

PART 2 EXECUTION

2.01 UTILITIES

- A. Locate existing underground utilities in areas of Work. The utilities shown on the Plans are approximate locations only. Provide adequate means of protection during excavation operations. Properly cap, raise, or lower to grade existing valve covers, cleanouts, manholes, drop inlets, or other utilities as shown on the Plans.

Contact Gopher State One Call (800-252-1166) to locate underground utilities prior to performing any excavation or demolition work at the site. The owner should also be consulted as to the presence of any "private" utilities within the work areas. Where utility locations are in question, the contractor shall retain the services of a private utility locator to determine the location of the underground utilities. The contractor will be responsible to repair any utilities damaged as part of the contractor's work for this project.

- B. Consult utility owner immediately for directions if uncharted or incorrectly charted piping or other utilities are encountered during the excavation. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. The Contractor shall repair damaged utilities to the satisfaction of the utility owner at no expense to the Owner.
- C. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Engineer.

2.02 USE OF EXPLOSIVES

- A. The use of explosives is not permitted.

2.03 EXCAVATION

- A. Remove topsoil, sod, grass, organic materials, or other unsuitable soil from areas to receive new materials.

- B. Sawcut the existing pavements and/or curbs to be removed to form a smooth vertical edge. Chiseling, jackhammering or blade ripping of the existing pavements will not be permitted except if approved in advance by the Engineer. Remove the pavements and curbs where indicated on the Plans.
- C. Excavate the areas to the depth shown on the Plans. After the required excavation has been completed, thoroughly clean the exposed vertical and bottom surfaces of all loose materials. The excavation bottom shall be firm and dry.
- D. Do not allow water to accumulate in the excavations. Remove water to prevent softening of subgrade or foundation soils or to eliminate other changes detrimental to the stability of the subgrade. Provide and maintain surface drainage and other dewatering system components necessary to convey water away from the excavations.
- E. For the excavation of the subgrade, conform to the elevations and dimensions shown within a tolerance of plus or minus 0.10 feet.
- F. Notify the Engineer at least 3 days in advance of any excavation so the Engineer can examine and evaluate the subsoils before placement of the new materials.
- G. All work specified in this section shall be performed by the Contractor at his own expense in accordance with the Contract. If additional excavations are required, the Contractor shall not proceed until given notice by the Owner or Geotechnical Engineer.
- H. Use all means necessary to prevent operations from producing dust. The Contractor shall be responsible for damage resulting from dust originating from their operations.

2.04 OVER-EXCAVATION NOT ORDERED, SPECIFIED OR SHOWN

- A. Excavations carried below the elevations or depths specified shall be backfilled to the required grade with the specified materials and compaction percentages. The Contractor shall perform such work at his own expense.

2.05 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. The Contractor shall remove and dispose of excess excavated material at their own expense.

2.06 FIELD QUALITY CONTROL

- A. Inspections will be performed during the excavation for the following.
 - 1. Review of the excavation cross-section.
 - 2. Evaluation of natural subgrade materials.

END OF SECTION

SECTION 31 25 00

TEMPORARY EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Temporary Erosion Prevention and Sediment Control.

PART 2 PRODUCTS

2.01 SILT FENCE FABRIC

- A. Ten Cate Mirafi 100X or approved equal woven fabric of polypropylene fibers treated to resist degradation caused by exposure to sunlight, resistant to soil chemicals, mildew, and insects. The fabric shall be non-biodegradable with the following properties:

Apparent Opening Size, ASTM D4751	USS #30 maximum
Minimum Weight	2.5 oz/sq. yd.
Tearing Strength, ASTM D4533	65 lb. minimum
Sediment Retention Efficiency	80% minimum
Flow Rate, ASTM D4491	10 gal/min/ft ² Minimum
UV Resistance at 500 hours, ASTM 4355,%	70 minimum

- B. The silt fence shall be ultraviolet stable and have high tear resistance and low permeability.

2.02 ROCK CONSTRUCTION ENTRANCE

- A. Washed aggregate with a nominal size of 1.5".

2.03 EROSION CONTROL FABRIC

- A. North American Green SC150BN. (Extended Term Erosion Control, 18 months; 2:1 to 1:1 slopes)

- 1. Material Data Requirements:

Top net:	Woven, 100% biodegradable, natural organic fiber, 9.3 lbs./ 1,000 square feet
Bottom net:	Woven, 100% biodegradable, natural organic fiber, 9.3 lbs./ 1,000 square feet
Matrix:	70% Straw at 0.35 lbs./ square yard 30% coconut at 0.15 lbs./ square yard
Thread:	Biodegradable

- B. Approved equal.

2.04 SEDIMENT LOGS

- A. Straw, wood fiber, or compost filter log meeting Mn/DOT 3897, size as indicated on the plans.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Installation techniques shall be in accordance with the Minnesota Construction Site Erosion and Sediment Control Planning Handbook and Minnesota Pollution Control Agency Best Management Practices.
- B. Perimeter and down gradient sediment control measures shall be installed prior to land disturbing activity. Install intermediate and temporary measures as construction progresses.
- C. Contractor personnel overseeing the SWPPP and installing and maintaining of BMPs shall be in compliance with the training requirements of the EPA-NPDES and MPCA Stormwater Permit for Construction Activity.
- D. Adjacent wetland areas shall be protected from sediment of ongoing construction activities.

3.02 SILT FENCE FABRIC

- A. Erect posts to support the silt fence fabric with post spacing maximum of 8 feet on-center.
- B. Install the fabric and firmly attach to the posts. Dig a trench along the intended face line and cover the fabric, or lay the bottom 6 inches on the ground and backfill over the fabric to create a good seal.

3.03 ROCK CONSTRUCTION ENTRANCE

- A. Construct the rock construction entrance a minimum of 20 feet wide and 50 feet in length, over soil separation fabric.

3.04 EROSION CONTROL FABRIC

- A. The installation of the erosion control fabric shall be in strict compliance with the manufacturer's installation instructions.
- B. Prepare the soil before installing the blankets, including the application of fertilizer and seed.
- C. Staple the fabric onto the slopes as recommended by the manufacturer.

3.05 SEDIMENT LOGS

- A. Install in accordance with manufacturer's instructions.

3.06 INSPECTION

- A. The Contractor shall inspect the entire site immediately after each rainfall event greater than 0.5 inches in 24 hours, daily during prolonged rainfall, and at least every 7 days. Inspections must include surface waters including drainage ditches and conveyance systems, for evidence of erosion and sediment deposit.
- B. The Contractor shall inspect adjacent streets for vehicle tracking of sediment daily.

3.07 MAINTENANCE

- A. Remove sediment when it reaches 1/2 the capacity of the BMP.
- B. BMPs shall be repaired or replaced when they become damaged, clogged, or otherwise ineffective.
- C. Maintenance and repairs shall be performed within 24 hours of discovery or as soon as field conditions allow access.
- D. Sweeping of tracked sediments on pavements shall be performed daily.
- E. Removal and stabilization of sediment deposited in surface waters shall be performed within 7 days of discovery.
- F. BMPs shall remain in place and be maintained until final stabilization is established.

3.08 RECORD KEEPING

- A. The SWPPP shall be kept onsite at all times.
- B. All inspections, maintenance, and changes shall be recorded in the SWPPP.

3.09 CLEANUP

- A. BMPs shall be removed when the up gradient areas have been permanently revegetated or paved.

END OF SECTION

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SECTION 32 05 00

AGGREGATES

PART 1 GENERAL

1.01 SUMMARY

- A.** Section Includes:
 - 1.** Aggregate base
 - 2.** Engineered fill
 - 3.** General backfill
 - 4.** Unsuitable material

1.02 SUBMITTALS

- A.** Submit laboratory test reports indicating the proposed aggregate grading meets the requirements specified herein.
- B.** Submit laboratory test results indicating the proposed aggregate base material meets the Los Angeles Abrasion requirements, and minimum percent crushed as specified herein.
- C.** The information must be current and represent the material to be supplied to the project site. If test information is not available from the supplier, the Contractor shall make arrangements and pay for required tests.

1.03 REFERENCES

- A.** Minnesota Department of Transportation (Mn/DOT) Materials Lab Supplemental Specifications for Construction, Current Edition
 - 1.** Section 3138 - Aggregate for Surface and Base Courses
 - 2.** Section 3149 - Granular Material
- B.** ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C.** ASTM C127, Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Course Aggregate
- D.** ASTM C131, Standard Test Method for Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E.** ASTM D698, Standard Test Method for Moisture Density Relations of Soils and Soil- Aggregate Mixtures, using a 5.5 pound Rammer and 12-inch Drop.
- F.** ASTM D2487, Standard Test Method for Classification of Soils for Engineering Purposes.

- G. ASTM D2922, Standard Test Method for Density of Soils and Soil-Aggregate In- Place by Nuclear Method (Shallow Depth).
- H. ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.04 QUALITY ASSURANCE

- A. In-place field density tests will be performed in accordance with ASTM D2922.
- B. The testing laboratory shall submit test reports to the Engineer and Contractor within 48 hours after the test has been performed.

PART 2 PRODUCTS

2.01 AGGREGATE BASE

- A. Class 5 Aggregate Base.

1. Crushed rock graded according to Mn/DOT 3138 Class 5 Gradation as follows:

Percent Passing by Weight						
Sieve Size	< 25% Recycled Aggregate		≥ 25% Recycled Aggregate < 75% Recycled Concrete		> 75% Recycled Concrete	
	Class 5	Class 5Q	Class 5	Class 5Q	Class 5	Class 5Q
2 inch	-	100	-	100	100	100
1-1/2 inch	100	-	100	-	-	-
1 inch	-	65 - 95	-	65 - 95	-	65 - 95
3/4 inch	70 - 100	45 - 85	70 - 100	45 - 85	45 - 100	45 - 85
3/8 inch	45 - 90	35 - 70	45 - 90	35 - 70	25 - 90	35 - 70
No. 4	35 - 80	15 - 45	35 - 80	15 - 45	15 - 65	15 - 45
No. 10	20 - 65	10 - 30	20 - 65	10 - 30	10 - 45	10 - 30
No. 40	10 - 35	5 - 25	10 - 35	5 - 25	0 - 20	0 - 20
No. 200	3 - 10	3 - 10	0 - 10	0 - 10	0 - 6	0 - 6

2. The coarse aggregate (that portion retained on the No. 4 sieve) shall have a percent of wear of not more than 40 at 500 revolutions as determined by ASTM C131.
3. Class 5 aggregate shall contain not more than 10 percent shale in the total sample except that when the part passing a No. 200 sieve exceeds 7 percent, the percentage of shale in the sample shall not exceed 7 percent.

- B. Recycled Content

1. Recycled aggregates composed only of recycled asphalt pavement (RAP), recycled concrete materials, recycled aggregate materials, or certified recycled glass, may be substituted for virgin aggregates.
2. Recycled aggregates must meet the requirements of the following table:

Requirement	Classes 1, 3, 4, 5, 5Q, and 6
Maximum Bitumen Content of Composite	3.50%
Maximum Masonry Block %	10%
Maximum Percentage of Glass ¹	10%
Maximum Size of Glass ¹	3/4" [19 mm]
Crushing (Class 5, 5Q and 6) ²	10% for Class 5 and 5Q ³ 15% for Class 6 ³
1 Glass must meet the requirements on the grading and base website. Combine glass with other aggregates during the crushing operation.	
2 Material crushed from quarries is considered crushed material	
3 If material is ≥ 20% (RAP + Concrete), Class 5 and 5Q crushing requirements are met	
3 If material is ≥ 30% (RAP + Concrete), Class 6 crushing requirement is met	

2.02 ENGINEERED FILL

- A. Granular material graded according to Mn/DOT 3149.2E as follows:

Sieve Size	Percent Passing By Weight
2 inch	100
No. 4	35 - 100
No. 10	20 - 70
No. 40	10 - 35
No. 200	3.0 - 10.5

2.03 GENERAL BACKFILL

- A. Clean, fine earth, sand, free from organic material, rocks, roots, brush, stumps or other large objects.
- B. The largest particle size shall be less than 2 inches in diameter.
- C. The backfill shall be brought up to within the specified elevation less the depth of topsoil required for the project.

2.04 UNSUITABLE MATERIALS

- A. Unsuitable soils include soils classified under ASTM D2487, which fall in the classifications of PT, OH, CH, MH, OL, CL, or ML.

PART 3 EXECUTION

3.01 AGGREGATE BASE AND ENGINEERED FILL PLACEMENT

- A.** Deposit and spread in uniform 6-inch maximum thickness layers (after compaction) without segregation of size.
- B.** Compact each layer of material until there is no further evidence of consolidation using a sheeps foot roller, pneumatic tired roller, or vibratory steel roller as approved by the Engineer.
- C.** Compact each layer of material to at least 100% of maximum dry density as determined in accordance with ASTM D698, the Standard Proctor Method. Use equipment that is consistently capable of achieving the required degree of compaction. Compact each layer over its entire area while the material is at the required moisture content.
- D.** Apply water to the material if the moisture content is below optimum during the mixing, spreading and compacting operations, when and in the amounts directed by the Engineer, as considered necessary for proper compaction.
- E.** Flooding, ponding, or jetting shall not be used for compaction.

3.02 BACKFILL PLACEMENT

- A.** Deposit and spread in uniform 8-inch minimum thick layers as shown on the Plans.
- B.** Compact each layer until there is no further evidence of consolidation using hand or machine operated compaction equipment.

3.03 FIELD QUALITY CONTROL

- A.** Quality assurance testing is the responsibility of the Owner. The Owner shall employ the services of an independent materials testing firm to provide the final test information. The Contractor may use their own personnel to provide tests of the materials during the placement and compaction operations; however, an independent testing firm must take the final tests. The testing firm shall test the materials as construction work is performed.
 - 1.** The Contractor shall arrange for the laboratory to perform field density tests in accordance with ASTM D2922 (nuclear densometer method).
 - 2.** Laboratory shall make at least one random field density test of new materials for every 250 square yards of area for each 12 inch depth of material, but in no case less than one test per 12 inch depth.
- B.** Provide additional density testing if the test results are below the specified density until passing test results are achieved. The additional tests shall be performed at the Contractor's expense.
- C.** Inspections will be performed during the excavation for the following.

1. Examination of fill soil, including the thickness and compaction of fill layers.

END OF SECTION

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SECTION 32 10 00

PLANT MIX BITUMINOUS PAVEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plant mix bituminous pavement

1.02 SUBMITTALS

- A. Submit a job mix formula to the Engineer at least 7 days in advance of plant mix bituminous paving, indicating conformance with the specifications. It shall be prepared by the Minnesota Department of Transportation or a commercial laboratory and signed by a registered Professional Engineer verifying that the job mix and the mix aggregate meet the specifications contained herein.

1.03 REFERENCES

- A. Minnesota Department of Transportation (MNDOT) Materials Supplemental Specifications for Construction, Current Edition
 - 1. Section 2360, Plant Mixed Asphalt Pavement.
 - 2. Section 2357, Bituminous Tack Coat.
 - 3. Section 3139, Graded Aggregate for Bituminous Mixtures.
- B. AASHTO M226, Viscosity Graded Asphalt Cement.
AASHTO T304, Uncompacted Void Content of Fine Aggregate.
AASHTO T176, Test Method for Plastic Fines in Graded Aggregates and Soil by use of the Sand Equivalent.
- C. ASTM C131, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- D. ASTM D1559, Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
- E. ASTM D2041, Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
- F. ASTM D3203, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- G. ASTM D4791, Test Method for Flat or Elongated Particles in Course Aggregate.
- H. ASTM D5821, Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

- I. International Building Code, Chapter 11.
- J. International Code Council A117.1, Accessible and Usable Buildings and Facilities.
- K. Minnesota Accessibility Code, Minnesota Rules Chapter 1341.

1.04 QUALITY ASSURANCE

- A. Quality assurance personnel shall remain at the project site on a full-time basis during plant mix bituminous placement.
- B. Compaction shall be by the Ordinary Compaction Method, unless stated otherwise.

1.05 WARRANTY

- A. Provide a warranty for the paving work against failure of defects for a period of one year after the final acceptance of the project by the Owner. Repair or replace, to the satisfaction of the Owner and Engineer, failed or defective work that occurs during the warranty period at no cost to the Owner.

PART 2 PRODUCTS

2.01 PLANT MIXED ASPHALT PAVEMENTS AGGREGATE GRADATIONS

**Broad Band Aggregate Gradation for Asphalt Mixtures
(% passing of total washed aggregate)**

Sieve Size	A	B	C	D
1"			100	
3/4"		100 ¹	85-100	
1/2"	100 ¹	85-100	45-90	
3/8"	85-100	35-90	-	100
No. 4	60-90	30-80	30-75	65-95
No. 8	45-70	25-65	25-60	45-80
No. 200	2.0-7.0	2.0-7.0	2.0-7.0	3.0-8.0

¹With the approval of the Engineer, the gradation broadband for the maximum aggregate size may be reduced to 97% passing for mixtures containing RAP, when the oversize material comes from the RAP source. The virgin material must remain 100% passing the maximum aggregate sieve size.

2.02 MIXTURE AGGREGATE REQUIREMENTS

Aggregate Blend Property	Traffic Level 2	Traffic Level 3	Traffic Level 4	Traffic Level 5
20-year Design ESAL's	<1 million	1-3 million	3-10 million	10-30 million
Min. Coarse Aggregate Angularity (ASTM D5821)				

(one face / two face), %-Wear	30/-	55/-	85/80	95/90
(one face / two face), %-Non-Wear	30/-	55/-	60/-	80/75
Min. Fine Aggregate Angularity (FAA) (AASHTO T304, Method A)				
%-Wear	40	42	44	45
%-Non-Wear	40	40	40	40
Flat and Elongated Particles, Max % by weight, (ASTM D4791)	-	10 (5:1 ratio)	10 (5:1 ratio)	10 (5:1 ratio)
Min. Sand Equivalent (AASHTO T 176)	-	-	45	45
Max. Total Spall in fraction retained on the #4 sieve				
Wear	5.0	2.5	1.0	1.0
Non-Wear	5.0	5.0	2.5	2.5
Maximum Spall Content in Total Sample				
Wear	5.0	5.0	1.0	1.0
Non-Wear	5.0	5.0	2.5	2.5
Maximum Percent Lumps in fraction retained on the #4 sieve	0.5	0.5	0.5	0.5
Class B Carbonate Restrictions				
Maximum % -#4 Final Lift/All Other Lifts	100/100	100/100	80/80	50/80
Maximum % +#4 Final Lift/All Other Lifts	100/100	100/100	50/100	0/100
Max. allowable scrap shingles – MWSS ⁽¹⁾ Wear/Non-Wear	5/5	5/5	5/5	5/5
Max. allowable scrap shingles – TOSS ⁽¹⁾ Final Lift/All other Lifts	5/5	5/5	0/5	0/0

(1) MWSS is manufactured waste scrap shingle and TOSS is tear-off scrap shingle

2.03 MIXTURE REQUIREMENTS

	Traffic Level 2	Traffic Level 3	Traffic Level 4	Traffic Level 5
20-year Design ESAL's	<1 million	1-3 million	3-10 million	10-30 million
Gyratory Mixture Requirements				
Gyrations for N _{design}	40	60	90	100
% Air voids at N _{design} , wear	4.0	4.0	4.0	4.0
% Air voids at N _{design} , Non-wear and all shoulder	3.0	3.0	3.0	3.0
Adjusted Asphalt Film Thickness, minimum μ	8.5	8.5	8.5	8.5
TSR*, minimum %	75 ⁽¹⁾	75 ⁽¹⁾	85 ⁽²⁾	85 ⁽²⁾
Fines / effective asphalt	0.6 – 1.2	0.6 – 1.2	0.6 – 1.2	0.6 – 1.2

* Use 6 inch [150 mm] specimens in accordance with 2360.2.1, "Field Tensile Strength Ratio (TSR)."

(1) MNDOT Min = 65, (2) MNDOT Min = 70

2.04 REQUIREMENTS FOR RECYCLED MATERIALS

- A. Control recycled materials used in mixture by evaluating the ratio of new added asphalt binder to total asphalt binder in accordance with Mn/DOT 2360.E.7, and as shown in the following table.

Requirements for Ratio of Added Asphalt Binder to Total Asphalt Binder, min %			
Specified Asphalt Grade	Recycled Material		
	RAS Only	RAS + RAP	RAP Only
PG XX-28, PG 52-34, PG 49-34, PG 64-22			
Wear	70	70	70
Non-Wear	70	70	70
PG 58-34, PG 64-34, PG 70-34			
Wear & Non-wear	80	80	80

2.05 PLANT-MIXED BITUMINOUS SURFACE / WEAR COURSE MNDOT 2360

- A. The bituminous mix designs for the surface or wear course shall be as follows:
 1. SP 12.5 with 30% maximum RAP (SPWEB340B).

2.06 PLANT-MIXED BITUMINOUS BASE / NON-WEAR COURSE MNDOT 2360

- A. The bituminous mix designs for the base or non-wear courses shall be as follows:
 1. SP 12.5 with no restrictions (SPNWB330B).

2.07 PERFORMANCE GRADE ASPHALT BINDER

- A. Only Performance Grade (PG) Asphalt Binder is approved for use. The inspection, sampling and testing of PG Asphalt Binder shall conform to the Schedule of Materials Control and the Combined State Binder Group Method of Acceptance for Asphalt Binders.
 1. Grade B Binder = PG 58S-28.

2.08 TACK COAT

- A. Tack coat to be used where plant mix pavement will be in contact with previously constructed asphalt or Portland cement concrete shall be CSS-1 or CSS-1H. Dilution of the emulsion to 7 parts emulsion to 3 parts water is only allowed by the supplier. No field dilution is allowed. Residual asphalt content must meet the requirements as set forth in MNDOT 2357.

Residual Asphalt Content		
	Minimum Residual Asphalt Content	
Emulsion	Undiluted	Diluted (7:3)
CSS-1 or CSS-1h	57%	40%

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- A. Do not begin paving until deficient areas have been corrected and are ready to receive paving.
- B. Pavement surfaces must be dry and completely free of dust, dirt, debris, and all loose materials and vegetation.
- C. Apply a uniform tack coat to the existing asphalt or concrete surface and the surface of each lift constructed. Tack each lift when placing multiple lifts in the same day. Apply the bituminous tack coat within the application rates shown in table below.

Surface Type	Application Rates (gallons/square yard)	
	Undiluted Emulsion	Diluted Emulsion (7:3)
New Asphalt	0.05-0.07	0.08-0.10
Old Asphalt and PCC	0.08-0.10	0.13-0.15
Milled Asphalt and Milled PCC	0.07-0.11	0.10-0.13

- D. Complete all reconstruction repairs in accordance with the specifications.

3.02 PLANT MIX BITUMINOUS

- A. Plant Mix Bituminous: The aggregate grading shall conform to the specification limits. Asphalt cement content shall be within 0.3 percent of the job mix formula optimum asphalt content.
- B. The trucks for hauling bituminous mixtures shall have tight, clean and smooth beds that have been sprayed with a minimum amount of approved anti-adhesive agent to prevent the mixture from adherence to the beds. Provide each truck with a cover of suitable material and size to protect the mixture from the weather.

3.03 PLANT MIX BITUMINOUS TEMPERATURE CONTROL

- A. The minimum laydown temperature in all courses (as measured behind the paver or spreading machine) of the bituminous mixture shall be in accordance with the temperature requirements specified herein:

Air Temp	Compacted Lift Thickness			
	1 inch	1 ½ inch	2 inch	3 inch or more
32 - 40	-	265	255	250
41 - 50	270	260	250	245
51 - 60	260	255	245	240
61 - 70	250	245	240	235
71 - 80	245	240	235	235
81 - 90	235	230	230	230
91 - up	230	230	230	230

- B. The plant mix bituminous mixture shall not exceed 310 degrees F. or the load will be rejected at Contractor's expense.

3.04 PLANT MIX BITUMINOUS PLACEMENT

- A. General: Place the plant mix bituminous on a prepared surface with a paver. Place inaccessible and small areas by hand. Place each course to the required elevation, cross-section, and compacted thickness. The in-place compacted thickness shall be plus or minus 1/4 inch of the planned thickness. Any area, which is constructed to less than the required minimum thickness, may be removed and replaced by the Contractor at the discretion of the Engineer, and at the Contractor's expense.
- B. Equipment: All equipment furnished by the Contractor shall be maintained and in sound mechanical condition capable of performing the work.
- C. Placement: The mixture shall be delivered to, and spread by, the plant mix bituminous paver. The mixture shall be laid in strips to minimize the number of longitudinal joints required.
- D. Paver:
 - 1. The paver shall be a self-contained, power-propelled unit provided with adjustable activated screed or strike-off assembly, heated, and capable of spreading and finishing courses of plant mix bituminous material. The paver must be capable of laying the plant mixed bituminous in widths applicable to the typical section and thickness shown on the Plans.
 - 2. Equip the paver with a control system capable of automatically maintaining elevations as specified. The control system shall be automatically actuated from either a reference line or surface through which a system of mechanical sensors will maintain the paver screed at a predetermined slope at the proper elevation to obtain the required surface. When directed, the transfer slope control system shall be made inoperative and the screed shall be controlled by sensor directed automatic mechanisms, which will independently control the screed elevation from the reference line or surface.
- E. Joints: Make joints between old and new pavements, or between a successive day's work, to ensure a continuous bond between the adjoining work. Construction joints shall be vertical and have the same texture, density, and smoothness as other sections of the bituminous course. Contact surfaces shall be clean and a tack coat applied.
- F. Wear Course: Place the surface wear course in maximum 2-inch lifts unless otherwise specified by the Engineer.
- G. Restrictions: No MNDOT bituminous mixtures shall be placed after November 1.
- H. ADA Compliance: Paved slopes in handicap accessible parking stalls and access aisles shall not exceed 2% in any direction.

3.05 COMPACTION/ROLLING

- A. Compact the plant mix bituminous mixture as quickly as possible after placement. Breakdown rolling shall immediately follow the paver. Intermediate rolling shall follow behind the breakdown rolling. Compaction of the pavement shall continue until in-place air voids are within the specified range. Finish rolling shall be performed at as high a temperature as practical and shall eliminate all the marks left from breakdown and intermediate rolling. All rolling must be completed before the bituminous mixture cools below 180 degrees F.
- B. Rollers:
 - 1. Steel-wheeled: Self-propelled and capable of reversing without backlash, weighing not less than 8 tons, and exerting a pressure on the rear drum of not less than 250 pounds per linear inch. When vibratory rollers are used, they shall operate at a frequency of 8 to 10 impacts per foot.
 - 2. Pneumatic-tired: Self-propelled, with a minimum of 7 tires, and exerting a pressure of not less than 200 pounds per inch of rolling width.
 - 3. Trench: Self-propelled, exerting a pressure of not less than 250 pounds per linear inch of rear roll.
- C. Rolling:
 - 1. Unless otherwise directed, begin rolling at the side and proceed longitudinally parallel to the paving lane centerline, overlapping each trip half the roller width, and gradually progressing to the crown of the parking lot or roadway.
 - 2. When the pavement abuts a previously placed lift, roll the longitudinal joint first followed by regular rolling procedures.
 - 3. On sloped sections, begin rolling at the low side and progress to the high side, by overlapping the longitudinal trips parallel to the paving lane centerline.
 - 4. Along forms, curbs, headers, walls, and other places not accessible to rollers, thoroughly compact the mixture with hot hand tampers or with mechanical tampers.
 - 5. The pavement shall be rolled so that no roller marks, ridges, porous spots or impressions are visible and the resulting surface has the required elevation and surface smoothness requirements.
- D. Compaction shall be obtained by the Ordinary Compaction Method. Uniformly compact each course until there is no further evidence of consolidation and all roller marks are eliminated. A minimum of two rollers shall be on the site at all times. A vibratory steel roller shall be used for breakdown and finish rolling and a pneumatic roller shall be used after breakdown, unless directed otherwise by the Engineer.
- E. Protection: Erect barricades to prohibit vehicular traffic from the pavement after final rolling until it has fully hardened and cooled to the same temperature as the surrounding soil or original asphalt pavement.

3.06 FIELD QUALITY CONTROL

- A. The plant mix bituminous pavement will be tested for compliance with the following project requirements. The tests and all costs shall be provided by the Owner.

1. Asphalt Cement Content.
 2. Plant mix bituminous density requirements, if necessary.
 3. Thickness requirements, as specified, +/- ¼ inch.
 4. Surface Smoothness, +/- 1/8 inch in 10 feet measured in any direction.
- B.** Test Frequency: the plant mix bituminous pavement shall be tested for mat thickness and surface smoothness during laydown.
- C.** The surface of the pavement when finished shall be of uniform texture, smooth, true to crown and elevation and free from defects to the satisfaction of the Engineer. When tested with a 10-foot straight edge in any direction, the maximum deviation of the surface shall not exceed 1/8 inch. Unsatisfactory joints, as determined by the Engineer, will be rejected and replaced at the Contractor's expense. Areas showing deviations greater than 1/8 inch or where surface water ponding will result, shall be milled, tack coated and repaved with bituminous.
- D.** Remove and replace areas mixed with foreign materials or defective areas as directed by the Engineer. Sawcut the areas, remove the existing bituminous and replace with new, hot plant mix bituminous. Compact the area by rolling to the air voids and smoothness specified. The removal and replacement of contaminated plant mix bituminous shall be done at no cost to the Owner.

END OF SECTION

SECTION 32 24 00

PAVEMENT STRIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pavement Striping.

1.02 SUBMITTALS

- A. Furnish the Engineer with the manufacturer's certification indicating the paint used for pavement striping meets the requirements specified.

PART 2 PRODUCTS

2.01 PAINT

- A. Pavement striping paint shall be a fast set lead free chlorinated polyolefin (Diamond Vogel), acrylic (Sherwin Williams) or approved equal marking paint that meets or exceeds all current Local, State and Federal codes and guidelines.
- B. The pavement colors shall be yellow for marking curbs and no parking areas; white for parking stalls, crosswalks, directional arrows, lane dividers, and handicap insignia unless indicated differently on the plans. The handicap insignia shall be placed over a 4'x 4' blue background with a white border, placed as close to the drive as possible.
- C. The pavement striping paint shall meet the following physical property requirements:

<u>Type</u>	<u>Chlorinated Polyolefin</u>	<u>Acrylic</u>
Finish:	Flat	Flat
Solvent	MED/Heptane	toluene/xylene/acetone
Solids by weight	69%, min.	70%, min
Solids by volume	46%, min.	51%, min.
Dry film thickness per coat	7 mils, min	7 mils, min
Wet film thickness per coat	16 mils, min	15 mils, min
Dry times at 70°F,ASTM D711	10 minutes	10 minutes
VOC, ASTM D3960	450 g/l max	430 g/l max.
Coverage – standard 4" line	300 ft/gal.	320 ft/gal.

PART 3 EXECUTION

3.01 APPLICATION

- A. Allow the paved surface to cure before painting. Apply the paint with mechanical equipment to produce uniform, straight edges. Apply the paint in accordance with the manufacturer's recommendations.
- B. Sweep and clean the paved surface to eliminate all loose materials and dust.
- C. Protect the newly painted areas from traffic until the paint has thoroughly dried and cured.
- D. The pavement stripes shall be 4" wide and all traffic markings will be the size and shape of the standards used within the State of Minnesota for traffic markings.
- E. Handicap parking stalls and access aisles shall be a minimum of 8' wide.
- F. All striping shall receive two coats of paint.

END OF SECTION

SECTION 32 26 00

SIGNS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Traffic signs.

1.02 SUBMITTALS

- A. Submit product data indicating that the materials meet the specification requirements.

1.03 REFERENCES

- A. Minnesota Manual for Uniform Traffic Control Devices for Streets and Highways.
- B. Federal Highway Administration, Department of Transportation, Washington D.C.
- C. Minnesota Department of Transportation (MN/DOT) Standard Specifications for Construction, Current Edition
 - 1. Section 3352, Signs, Delineators, and Markers.
 - 2. Section 3401, Flanged Channel Sign Posts.

PART 2 PRODUCTS

2.01 FABRICATION, COLOR AND MATERIALS

- A. Fabrication of traffic signs and markers: Conform to the Minnesota Manual for Uniform Traffic Control Devices for Streets and Highways.
- B. Colors: Conform to the color tolerance charts available from the Federal Highway Administration, Department of Transportation, Washington D.C., unless otherwise permitted or specified herein.
- C. Sign material: Sheet aluminum complying with ASTM B209 for alloy 5052-H38 or 6061-T6, with a minimum thickness of .080 +/- .005 inch, showing no warp or twist, and when mounted, the finished sign will lay flat against the post or mounting structure.
- D. Reflective Sign Sheeting: Reflective sheeting shall meet the performance requirements of ASTM D4956 for Type I sheeting.
- E. Posts:
 - 1. Bollards: Galvanized, 6-inch diameter Schedule 40 steel bollards filled with concrete and with a ¼" thick yellow LDPE plastic cover securely attached to the posts with mechanical fasteners.

2. Channel posts: Hot-rolled high tensile steel, weighing at least 2.5 pounds per foot conforming to MN/DOT 3401 with 3/8" diameter holes and galvanized in accordance with ASTM A123.
3. Tube posts: Perforated square tube, with hot-drip galvanized zinc coating, minimum 2" x 2".

F. Hardware: Aluminum alloy or stainless steel as recommended by the manufacturer.

2.02 PARKING SIGNS

A. The signs shall meet the following criteria:

<u>Sign No.</u>	<u>Name</u>	<u>Size</u>	<u>Color</u>
R7-8	Disability Parking	12" x 18"	White on Blue
n/a	No Parking – Access Aisle	12" x 18"	White on Blue

PART 3 EXECUTION

3.01 EXECUTION

- A. Perform no work on the jobsite until all underground utilities are located. This may require the contractor to retain the services of a private utility locating company. Damage to underground utilities shall be repaired at the Contractor's expense to the satisfaction of the utility owner.
- B. Sign locations on the Plans are approximate only. The final determination of the sign locations will be made in the field by the Engineer/Owner.
- C. Install 2 posts for signs with any dimension 36" or greater.
- D. The posts shall be plumb above the ground. The posts that are bent or otherwise damaged, as determined by the Engineer, shall be removed from the site and replaced at the Contractor's expense.
- E. Channel posts in turf shall be driven firmly into the ground. After driving, the top of the posts shall have substantially the same cross-sectional dimensions as the body of the post.
- F. Sign post bollards in pavement shall be set in a 12" diameter by 60" deep concrete foundation. The bollard shall be filled with concrete. Embed the channel post in the concrete fill a minimum of 12". Install a LDPE cover over the bollard. Seal all gaps at the post penetration.
- G. Sign height and location requirements shall conform to the Minnesota Manual of Uniform Traffic Control Devices, current edition and Minnesota Accessibility Code, Chapter 1341.
- H. Clean work area of all excess soil and concrete. Restore to original conditions.

END OF SECTION

SECTION 32 31 00 - CHAIN LINK FENCING

PART 1 - GENERAL

1.01 SCOPE

The work included in this Section of the Specifications consists of furnishing all labor, equipment and materials, and in performing all operations in connection with the construction and installation of all chain link fencing, and gates in strict accordance with this Section of the Specifications and drawings.

1.02 LIMITS OF WORK

The Construction Limits within which all work included in this Section is to be confined are shown on the construction drawings.

1.03 RELATED SECTIONS

1. Demolition of Existing Chain Link - Section 02 10 00 – Selective Demolition

1.04 SUBMITTALS

Submit product information on specified hinges latches and gate hardware. Submit shop drawings for gates, poles, gate motor and access card reader and concrete footings.

PART 2 - PRODUCTS

2.01 MATERIALS

All Fencing

Rails: Top, intermediate and bottom rails shall be 1.90" o.d., schedule 40, (2.72 lb/ft) galvanized steel pipe. Refer to drawings for location and application of mid-rails.

Eight-foot-high Corner Posts or Gate Posts: Corner posts shall be shall be 3-1/2" o.d., schedule 40, (6.65 lb/ft) galvanized steel pipe.

Eight-foot-high Posts: Posts shall be shall be 3" o.d., schedule 40, (4.64 lb/ft) galvanized steel pipe.

Fittings: All fittings shall be galvanized pressed steel.

Tie Wires: Ties shall be 9 gauge aluminum as specified under installation.

Barb Wire: All aluminum barbed wire is .110" dia. wire with four-point barbs of .080" dia. wire, 5052 H-38 main, 6061 T94 barb. Top Tension Wire & Barbed Wire (3 Strands) with triangular brace, commercial grade. Vertical arm.

9 Gauge Fabric: Wire: ASTM A 392 Standard Specification for Zinc Coated Steel Chain Link Fence Fabric, Type 2, Class 2. Wire shall have a breaking strength of 1290 lb/ft.

Where indicated on the drawings, install 9 gauge, hot-dipped, galvanized fabric, woven into two-inch diamond mesh. Both selvages shall be knuckled.

6 Gauge Fabric: Wire: ASTM A 392 Standard Specification for Zinc Coated Steel Chain Link Fence Fabric, Type 2, Class 2. Wire shall have a breaking strength of 2170 lb/ft.

Where indicated on the drawings, install 6 gauge, hot-dipped, galvanized fabric, woven into two inch diamond mesh. Both selvages shall be knuckled.

Gates:

Gate Posts: (See above)

Gate Frames: Frame and mid-rail shall be 1.9" o.d., schedule 40, galvanized steel pipe at 2.72 lb./ft., welded at each corner. Gates shall have a positive type latching device with provision for padlocking and hinges as required to secure gate.

Gate Hinges: Hinges for all gates shall be pressed steel Bulldog Industrial Hinges by Master Halco, Inc. or approved equal.

Gate Latches: Latches for double gates shall be the Pioneer Industrial Gate Latch by Pioneer Semmerling (763-424-8383) or approved equal. Latches for single gates shall be Strong Arm Industrial Gate Latch by Hoover Fence Co. (800-355-2335) or approved equal.

Fittings: All fittings shall be galvanized pressed steel.

Tie Wires: Ties shall be 9-gauge aluminum.

Braces: Braces shall consist of a mid-rail, 1.9" o.d. pipe, welded at each end.

Bolts, nuts, washers and miscellaneous fasteners: Hot dipped galvanized steel.

Barb Wire:

All aluminum barbed wire is .110" dia. wire with four point barbs of .080" dia. wire, 5052 H-38 main, 6061 T94 barb. Top Tension Wire & Barbed Wire (3 Strands) with triangular brace, commercial grade. Vertical arm.

2.02 MISCELLANEOUS MATERIALS

All materials shall be new and of the best quality for the purpose intended. All tension bars, bolts and miscellaneous fasteners shall be hot dipped galvanized unless indicated otherwise.

Bolts, nuts, washers and miscellaneous fasteners: Hot dipped galvanized steel.

No plastic or fiberglass components are allowed on chain link fencing.

PART 3 - EXECUTION

3.01 INSTALLATION

Post Setting

End, corner, line, pull, backstop, gate posts, and as indicated on the drawings, shall be set in concrete with size and depth of footings of the sizes indicated on the drawings. Some line posts may be air-driven as directed on the drawings.

All posts shall be set in a straight line and plumb.

Spacing of posts shall be as indicated on the drawings.

Fabric Fastening and Stretching

Install fabric according to ASTM F 567. The chain link fabric shall be securely fastened to all terminal posts by 1/4" x 3/4" tension bars with 9 gauge aluminum tie wires, spaced approximately 14" o.c., and to the line posts and rails with 9 gauge aluminum tie wires, spaced approximately 14" o.c. Both ends of all tie wires shall have, at minimum, a 360 degree turn around fabric wire.

Clean-Up

Upon completion of the installation, all debris created by the installation shall be removed or disposed of as directed by the owner or his representative.

END OF SECTION



Vertical Pivot Gate & Operator Specifications

MODEL:	VPG-24
LISTING:	UL 325 Listed / CSA Listed CAN/CSA—C22.2 No. 247
OPERATOR:	Dual belt/high torque reduction system. Counter balanced. Safety locking pins used during preventative maintenance to negate vertical and horizontal movement.
OPERATOR CONSTRUCTION:	Frame: 2" Sq., 11 Ga. (.120) Steel Mounting Pads: 304 SS Skins: 18 Ga. Galvaneal Sheet
OPERATOR SIZE:	Type: VPG-24 Length: 68" Height: 51" Width: 30"
PAINT:	PPG Commercial Coating 2-part High Solids Polyurethane: Standard colors: Black, White, Brown, Green & Gray. Custom colors available.
DUTY CYCLE:	Continuous.
POWER SUPPLY:	120VAC-Single Phase (15 or 20 Amp) service (Optional: 240 VAC, 10 Amp) with 24v DC battery back up. (2) Group 24, 12v, Marine Starting, sealed batteries required (NOT INCLUDED!)
POWER MAINTENANCE:	24v built-in battery maintainer keeps batteries charged for built-in battery back-up. "Over-Charge" protection built-in.
CONTROL CIRCUITRY:	Solid state coated control board in electrical enclosure. Sealed proximity switches ensure weather and moisture proof integrity. (Boards tested to -40° F).
CONTROL WIRING:	16 & 18 Ga. single conductor. Copper w/electrolytic copper compression terminals tin-plated for max corrosion prevention.
GEAR MOTOR:	Horse Power: 1/3 Gear Type: Hardened steel Bearing Type: Ball Gear Lube: Dextron II
OPEN / CLOSING CYCLES:	Standard Speed: 10 – 12 seconds
DELAYED CLOSING:	Adjustable from 0 – 60 seconds.
OBSTRUCTION SENSOR:	Adjustable IRD senses obstructions opening or closing.
SECURITY BREACH PROTECTION:	24V built in system brake when 120v or battery power is present.
REVERSING EQUIPMENT:	Optional Reversing/Safety Loop, Leading Reversing Edge, and Infrared Reversing Beams.
OPTIONAL ACCESSORIES:	Access controls, solar power, operator gear motor heater, extreme cold weather package, MUTCD reflective tape, warning lights, audible devices and emergency options (SOS/Opticon/Click-2-Enter).
GATE CONSTRUCTION:	12' - 20': 2" Sq., 11 Ga. (.120) Steel Tubing. Over 20': 2 1/2" Sq., 7 Ga. (.187) Aluminum Tubing
CHAIN LINK CONSTRUCTION:	2 3/8", Sch. 40, 20 & 2" x .065" Galvanized Steel Tubing 9 Ga. Galv. Fabric from 12' up to 22' 2 3/8", Sch. 80, 40 & 2" x 1/8" 6061 Aluminum Tubing 9 Ga. Alum. Fabric over 22' up to 25'
GATE LENGTHS:	10' - 25' (Consult factory for gates over 25')
GATE HEIGHTS:	4' - 8' from pad grade (Barracuda 3'-4'). Consult factory for gates over 8' high. Gates over 8' will require special crating and freight arrangements.
PICKET CONSTRUCTION:	Steel: 3/4" Sq. 18 Ga. Galv. Steel Tubing is standard. Aluminum: 3/4" Aluminum Tubing, 1/8" Wall is standard. Note: Consult factory for special sizes, spacing, and custom materials.
GATE HARDWARE:	Gate mounting hardware is 304 stainless steel
WIND BRACING:	Cable: 75 mph design, 1/4" aircraft coated cable 16' - 20' Rigid Masted: Alum. Over 20', compliant with IBC Section 1609.6 Simplified Wind Load Method for 90 mph wind loading and the 150 mph hurricane wind loading.
DOUBLE GATES:	Control Board can be set to accommodate control of a 2nd Operator or Sally Port with another Operator.
SHIPPING WEIGHT:	Typical VPG-24 Operator with 6' high x 20' long picket style gate = 1,600 lbs.
WARRANTY:	Residential: Five (5) years. Industrial/Commercial: Three (3) years from date of shipment on manufactured components and workmanship. Purchased components and accessories are covered under their respective warranties. (see full Warranty for details)

AutoGate, Inc., 7306 Driver Rd., PO BOX 50, Berlin Heights, Ohio 44814

www.AutoGate.com

800-944-4283

Sales@AutoGate.com

SECTION 33 30 00

SANITARY SEWER

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sanitary sewer pipe.

1.02 CODES

- A. All work shall comply with the most current requirements of the Minnesota Department of Health, the Minnesota Plumbing Code published by the Minnesota Department of Labor and Industry Codes Division, latest edition.

1.03 REFERENCES

- A. Minnesota Plumbing Code published by the Minnesota Department of Health, latest edition.
- B. ASTM 1785, Specification for Type Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Inspect the materials delivered to the site for damage and store the materials with a minimum of handling. The materials shall be kept under cover and out of the direct sunlight. Do not store the materials directly on the ground. Keep the inside of the pipes and fittings free from dirt and debris.

1.05 QUALITY ASSURANCE

- A. Quality assurance personnel shall be at the project site on an intermittent basis during the storm sanitary sewer system placement.

1.06 SUBMITTALS

- A. The Contractor shall submit for approval complete shop drawings and details for all structures, pipes, castings, fittings, and accessories. Submittal shall include all the manufacturer's product data, certifications, dimensions, sizes, types, and installation requirements.

1.07 SITE CONDITIONS

- A. The existing underground utilities, as shown on the plans, are located in accordance with available data, but the locations may vary and cannot be guaranteed. The exact locations

shall be determined by the Contractor as the work proceeds. The excavation work shall be done carefully so as to avoid damaging the existing utilities.

- B. The Contractor shall provide for the protection, temporary removal and replacement, or relocation of said obstructions as required for the performance of the work required in these contract documents. No extra payment will be made for this work.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPE

- A. All pipe shall be new and unused.
- B. Polyvinyl chloride (PVC) pipe, ASTM D1785 Schedule 40.
- C. Provide pre-insulated pipe where indicated on the plans.

2.02 PIPE BEDDING MATERIAL

- A. The pipe bedding shall consist of clean pit-run sand or fine gravel, free from deleterious matter and rocks over 1 inch in diameter.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

- A. Shape the bottom of the trench to give substantially uniform circumferential support to the lower fourth of each pipe allowing for pipe bedding material. Pipe laying shall proceed up-grade with the groove (bell) ends in the up-grade direction. Adjust the tongues in grooves to produce a uniform space. Lay each pipe true to line and grade to form a close concentric joint with the adjoining pipe. Blocking or wedging between tongues and grooves will not be permitted. As the work progresses, clean the interior of the pipe free of dirt and extraneous materials.
- B. Keep the trenches free from water until the pipe jointing is completed. Do not lay the pipe when conditions of the trench or the weather are unsuitable for such work. Keep the open ends of the pipe and fittings securely closed at all times when the work is not in progress.
- C. The bedding material shall be placed uniformly over the trench bottom to a depth of not less than 3 inches. The bedding shall be shaped to provide uniform support to the lower fourth of the pipe for its entire length. Depressions shall be made in the bedding material to accommodate the joints. The pipe bedding material shall be carried to 6 inches above the tip of the pipe. The remaining trench backfill material shall be on-site material similar in composition to the surrounding subsoils.

3.02 JOINT CONSTRUCTION

- A.** Make joints with approved primer and glue. Clean and dry the surfaces to receive cements, or adhesives. Affix joints not more than 24 hours prior to the installation of the pipe. Protect the joint from sun, wind, dust or other deleterious agents at all times.
- B.** Before the installation of the pipe, inspect joints and remove and replace loose or improperly attached joints.
- C.** If the joint becomes loose, remove the pipe, and remake the joint.

3.03 FIELD QUALITY CONTROL

- A.** Check each straight run of pipe for gross deficiencies by holding a light in the manholes. The light shall show a practically full circle through the pipe when viewed from the adjoining end of the line.
- B.** Leakage testing shall be performed on sewer lines and service connections by the Contractor at his own expense. Testing may be either Hydrostatic or Air Test Method in accordance with the City Engineers Association of Minnesota standard specifications and the Minnesota Plumbing Code.

END OF SECTION

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Interior Lighting Compliance Certificate

Project Information

Energy Code: 90.1 (2019) Standard
 Project Title: MLBO DII
 Project Type: Alteration

Construction Site: 20898 360th St
 McGregor, Minnesota 55760
 Owner/Agent: MILLE LACS BAND OF OJIBWE
 Minnesota
 Designer/Contractor: Brian Gallagher
 Emanuelson-Podas, Inc.

Allowed Interior Lighting Power

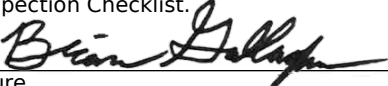
A Area Category	B Floor Area (ft ²)	C Allowed Watts / ft ²	D Allowed Watts
1-Common Space Types:Office - Enclosed <=250 sq ft	501	0.74	371
2-Common Space Types:Workshop	6352	1.26	8004
3-Common Space Types:Storage >=50 - <=1000 sq.ft.	1350	0.43	580
4-Common Space Types:Electrical/Mechanical	190	0.43	82
5-Common Space Types:Restrooms	151	0.63	95
6-Common Space Types:Classroom/Lecture/Training	719	0.71	510
7-Common Space Types:Corridor/Transition <8 ft wide	237	0.41	97
Total Allowed Watts =			9739

Proposed Interior Lighting Power

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixture	D Fixture Watt.	E (C X D)
<u>Common Space Types: Office - Enclosed <=250 sq ft (501 sq.ft.)</u>				
A1: Other:	1	10	42	420
<u>Common Space Types: Workshop (6352 sq.ft.)</u>				
G1: Other:	1	35	84	2940
<u>Common Space Types: Storage >=50 - <=1000 sq.ft. (1350 sq.ft.)</u>				
A1: Other:	1	6	42	252
G2: Other:	1	12	42	504
<u>Common Space Types: Electrical/Mechanical (190 sq.ft.)</u>				
A1: Other:	1	3	42	126
<u>Common Space Types: Restrooms (151 sq.ft.)</u>				
A1: Other:	1	3	42	126
<u>Common Space Types: Classroom/Lecture/Training (719 sq.ft.)</u>				
A2: Other:	1	9	42	378
<u>Common Space Types: Corridor/Transition <8 ft wide (237 sq.ft.)</u>				
G3: Other:	1	3	42	126
G2: Other:	1	2	42	84
Total Proposed Watts =				4956

Interior Lighting Compliance Statement

Compliance Statement: The proposed interior lighting alteration project represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed interior lighting systems have been designed to meet the 90.1 (2019) Standard requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Brian Gallagher - Electrical Designer  06/17/2024
Name - Title Signature Date



Exterior Lighting Compliance Certificate

Project Information

Energy Code: 90.1 (2019) Standard
 Project Title: MLBO DII
 Project Type: Alteration
 Exterior Lighting Zone: 3 (Other (LZ3))

Construction Site: 20898 360th St
 McGregor, Minnesota 55760
 Owner/Agent: MILLE LACS BAND OF OJIBWE
 Minnesota
 Designer/Contractor: Brian Gallagher
 Emanuelson-Podas, Inc.

Allowed Exterior Lighting Power

A Area/Surface Category	B Quantity	C Allowed Watts /	D Tradable Wattage	E Allowed Watts (B X C)
Parking area	36000 ft2	0.06	Yes	2160
Total Tradable Watts (a) =				2160
Total Allowed Watts =				2160
Total Allowed Supplemental Watts (b) =				500

(a) Wattage tradeoffs are only allowed between tradable areas/surfaces.

(b) A supplemental allowance equal to 500 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Proposed Exterior Lighting Power

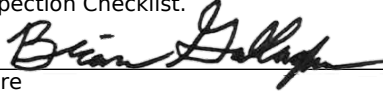
A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixture	D Fixture Watt.	E (C X D)
<u>Parking area (36000 ft2): Tradable Wattage</u>				
P1: Other:	1	1	90	90
N1: Other:	1	4	26	104
N2: Other:	1	4	55	220
Total Tradable Proposed Watts =				414

Exterior Lighting PASSES

Exterior Lighting Compliance Statement

Compliance Statement: The proposed exterior lighting alteration project represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed exterior lighting systems have been designed to meet the 90.1 (2019) Standard requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Brian Gallagher - Electrical Designer
Name - Title


Signature

06/17/2024
Date



Inspection Checklist

Energy Code: 90.1 (2019) Standard

Requirements: 0.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Plan Review	Complies?	Comments/Assumptions
4.2.2, 8.4.1.1, 8.4.1.2, 8.7 [PR6] ²	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the electrical systems and equipment and document where exceptions are claimed. Feeder connectors sized in accordance with approved plans and branch circuits sized for maximum drop of 3%.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
4.2.2, 9.4.3, 9.7 [PR4] ¹	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the interior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. Information provided should include interior lighting power calculations, wattage of bulbs and ballasts, transformers and control devices.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.7 [PR8] ¹	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the exterior lighting and electrical systems and equipment and document where exceptions to the standard are claimed. Information provided should include exterior lighting power calculations, wattage of bulbs and ballasts, transformers and control devices.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Rough-In Electrical Inspection	Complies?	Comments/Assumptions
8.4.2 [EL10] ²	At least 50% of all 125 volt 15- and 20-Amp receptacles are controlled by an automatic control device.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
8.4.3 [EL11] ²	New buildings have electrical energy use measurement devices installed. Where tenant spaces exist, each tenant is monitored separately. In buildings with a digital control system the energy use is transmitted to to control system and displayed graphically.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.1 [EL1] ²	Automatic control requirements prescribed in Table 9.6.1, for the appropriate space type, are installed. Mandatory lighting controls (labeled as 'REQ') and optional choice controls (labeled as 'ADD1' and 'ADD2') are implemented.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.1 [EL2] ²	Independent lighting controls installed per approved lighting plans and all manual controls readily accessible and visible to occupants.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.1f [EL13] ¹	Daylight areas under skylights and roof monitors that have more than 150 W combined input power for general lighting are controlled by photocontrols.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.4 [EL3] ²	Automatic lighting controls for exterior lighting installed.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.4d [EL21] ²	Outdoor parking area luminaires \geq 78W and \leq 24 ft height controlled to reduce wattage by 50% when area unoccupied over 15 minutes. Controlled power limited to \leq 1500W.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.4.1.3 [EL4] ¹	Separate lighting control devices for specific uses installed per approved lighting plans.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.6.2 [EL8] ¹	Additional interior lighting power allowed for special functions per the approved lighting plans and is automatically controlled and separated from general lighting.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
8.7.1 [FI16] ³	Furnished as-built drawings for electric power systems within 30 days of system acceptance.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
8.7.2 [FI17] ³	Furnished O&M instructions for systems and equipment to the building owner or designated representative.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	
9.2.2.3 [FI18] ¹	Interior installed lamp and fixture lighting power is consistent with what is shown on the approved lighting plans, demonstrating proposed watts are less than or equal to allowed watts.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	<i>See the Interior Lighting fixture schedule for values.</i>
9.4.2 [FI19] ¹	Exterior lighting power is consistent with what is shown on the approved lighting plans, demonstrating proposed watts are less than or equal to allowed watts.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	<i>See the Exterior Lighting fixture schedule for values.</i>
9.4.4 [FI20] ¹	At least 75% of all permanently installed lighting fixtures in dwelling units have ≥ 55 lm/W efficacy or a ≥ 45 lm/W total luminaire efficacy.	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

Additional Comments/Assumptions:

1	High Impact (Tier 1)	2	Medium Impact (Tier 2)	3	Low Impact (Tier 3)
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