Tazewell County Highway Department

AUTHORIZATION TO BID FORM

Addenda will be published to our Bid Letting page in the same manner as the plans and specifications. It is the sole responsibility of the plan holders to periodically check the website for plan addenda.

ALL BIDDERS PLANNING TO PLACE A BID MUST FILL OUT THIS FORM TO BE AUTHORIZED TO BID.

- This form must be completed, signed and either faxed to (309) 925-5533 or emailed to jsciortino@tazewell-il.gov.
- Failure to submit this completed form will result in the bid not being accepted.
- Contractors may verify we have received their Authorization to Bid form by checking the **Plan Holders List** found under the corresponding letting date.
- If an email address is provided, a Notice of Addenda will be sent when updates are available.
- Bid results are typically posted by noon on the day of the letting and are preliminary until approved by the County Board on the last Wednesday of the month.

Company Name:	
Address:	
Phone:	
Fax:	
Email:	
Bid Letting Date:	

Projects Intending to Bid on:

Section Number:	Description:

Tazewell County Highway Department
21308 Illinois Route 9
Tremont, IL 61568
p: (309) 925-5532 • f: (309) 925-5533 • jsciortino@tazewell-il.gov

Illinois Department of Transportation

Local Public Agency
Formal Contract Proposal

COVER SHEET

Proposal Submitted By:

Contractor's Name

Contractor's Address | City | State | Zip Code

STATE OF ILLINOIS

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

Route(s) (Street/Road Name)	Type of Funds
Highway Office and Shop Building Renovations	MFT and Local

☐ Proposal Only ☐ Proposal and Plans ☒ Proposal only, plans are separate

Submitted/Approved
For Local Public Agency:

For a County and Road District Project

Submitted/Approved

Highway Commissioner Signature & Date

Submitted/Approved

County Engineer/Superintendent of Highways Signature & Date

Dan Parr Digitally signed by Dan Parr Date: 2024.02.22 10:16:33 -06'00'

For a Municipal Project

Submitted/Approved/Passed

Signature & Date

Official Title

Department of Transportation

Released for bid based on limited review

Regional Engineer Signature & Date

Note: All proposal documents, including Proposal Guaranty Checks or Proposal Bid Bonds, should be stapled together to prevent loss when bids are processed.

Local Public Agency	County	Section Number	Route(s) (Street/Road Name)
Tazewell County	Tazewell	21-00000-06-MG	Highway Office and Shop Buildi

NOTICE TO BIDDERS

Sealed proposals for the project described below will be received at the office of the Tazewell County Engineer (Name of Office)

21308 Illinois Route 9; Tremont, IL 61568 (Address) until 1:30 PM (Time) on 04/15/24 (Date).

Sealed proposals will be opened and read publicly at the office of the Tazewell County Engineer (Name of Office)

21308 Illinois Route 9; Tremont, IL 61568 (Address) at 1:30 PM (Time) on 04/15/24 (Date).

DESCRIPTION OF WORK

Location	Project Length
21308 Illinois Route 9; Tremont, IL 61568	n/a

Proposed Improvement

Renovation of portions of the automotive repair shop and attached office. Work includes concrete, masnonry, metal railings, windows and doors, floor and wall construction and finishes, bathroom fixtures, plumbing, HVAC, and electrical work.

1. Plans and proposal forms will be available in the office of

the Tazewell County Engineer
21308 IL Route 9
Tremont, IL 61568

2. ☐ Prequalification

   If checked, the 2 apparent as read low bidders must file within 24 hours after the letting an "Affidavit of Availability" (Form BC 57) in triplicate, showing all uncompleted contracts awarded to them and all low bids pending award for Federal, State, County, Municipal and private work. One original shall be filed with the Awarding Authority and two originals with the IDOT District Office.

3. The Awarding Authority reserves the right to waive technicalities and to reject any or all proposals as provided in BLRS Special Provision for Bidding Requirements and Conditions for Contract Proposals.

4. The following BLR Forms shall be returned by the bidder to the Awarding Authority:
   a. Local Public Agency Formal Contract Proposal (BLR 12200)
   b. Schedule of Prices (BLR 12201)
   c. Proposal Bid Bond (BLR 12230) (if applicable)
   d. Apprenticeship or Training Program Certification (BLR 12325) (do not use for project with Federal funds.)
   e. Affidavit of Illinois Business Office (BLR 12326) (do not use for project with Federal funds)

5. The quantities appearing in the bid schedule are approximate and are prepared for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished according to the contract. The scheduled quantities of work to be done and materials to be furnished may be increased, decreased or omitted as hereinafter provided.

6. Submission of a bid shall be conclusive assurance and warranty the bidder has examined the plans and understands all requirements for the performance of work. The bidder will be responsible for all errors in the proposal resulting from failure or neglect to conduct an in depth examination. The Awarding Authority will, in no case, be responsible for any costs, expenses, losses or changes in anticipated profits resulting from such failure or neglect of the bidder.

7. The bidder shall take no advantage of any error or omission in the proposal and advertised contract.

8. If a special envelope is supplied by the Awarding Authority, each proposal should be submitted in that envelope furnished by the Awarding Agency and the blank spaces on the envelope shall be filled in correctly to clearly indicate its contents. When an envelope other than the special one furnished by the Awarding Authority is used, it shall be marked to clearly indicate its contents. When sent by mail, the sealed proposal shall be addressed to the Awarding Authority at the address and in care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and at the place specified in the Notice to Bidders. Proposals received after the time specified will be returned to the bidder unopened.

9. Permission will be given to a bidder to withdraw a proposal if the bidder makes the request in writing or in person before the time for opening proposals.

Local Public Agency	County	Section Number	Route(s) (Street/Road Name)
Tazewell County	Tazewell	21-00000-06-MG	Highway Office and Shop Buildi

PROPOSAL

1. Proposal of _____
Contractor's Name

_____.
Contractor's Address

2. The plans for the proposed work are those prepared by Crawford, Murphy & Tilly, Inc.
and approved by the Department of Transportation on Mar 1, 2024.

3. The specifications referred to herein are those prepared by the Department of Transportation and designated as "Standard Specifications for Road and Bridge Construction" and the " Supplemental Specifications and Recurring Special Provisions" thereto, adopted and in effect on the date of invitation for bids.

4. The undersigned agrees to accept, as part of the contract, the applicable Special Provisions indicated on the "Check Sheet for Recurring Special Provisions" contained in this proposal.

5. The undersigned agrees to complete the work within _____ working days or by 11/15/24 unless additional time is granted in accordance with the specifications.

6. The successful bidder at the time of execution of the contract will be required to deposit a contract bond for the full amount of the award. When a contract bond is not required, the proposal guaranty check will be held in lieu thereof. If this proposal is accepted and the undersigned fails to execute a contract and contract bond as required, it is hereby agreed that the Bid Bond of check shall be forfeited to the Awarding Authority.

7. Each pay item should have a unit price and a total price. If no total price is shown or if there is a discrepancy between the products of the unit price multiplied by the quantity, the unit price shall govern. If a unit price is omitted, the total price will be divided by the quantity in order to establish a unit price. A bid may be declared unacceptable if neither a unit price nor a total price is shown.

8. The undersigned submits herewith the schedule of prices on BLR 12201 covering the work to be performed under this contract.

9. The undersigned further agrees that if awarded the contract for the sections contained in the combinations on BLR 12201, the work shall be in accordance with the requirements of each individual proposal for the multiple bid specified in the Schedule for Multiple Bids below.

10. A proposal guaranty in the proper amount, as specified in BLRS Special Provision for Bidding Requirements and Conditions for Contract Proposals, will be required. Bid Bonds will be allowed as a proposal guaranty. Accompanying this proposal is either a bid bond, if allowed, on Department form BLR 12230 or a proposal guaranty check, complying with the specifications, made payable to: County Treasurer of Tazewell County.
The amount of the check is _____ (_____).

Attach Cashier's Check or Certified Check Here

In the event that one proposal guaranty check is intended to cover two or more bid proposals, the amount must be equal to the sum of the proposal guaranties which would be required for each individual bid proposal. If the proposal guaranty check is placed in another bid proposal, state below where it may be found.

The proposal guaranty check will be found in the bid proposal for: Section Number _____.

Local Public Agency	County	Section Number	Route(s) (Street/Road Name)
Tazewell County	Tazewell	21-00000-06-MG	Highway Office and Shop Buildi

CONTRACTOR CERTIFICATIONS

The certifications hereinafter made by the bidder are each a material representation of fact upon which reliance is placed should the Department enter into the contract with the bidder.

1. **Debt Delinquency.** The bidder or contractor or subcontractor, respectively, certifies that it is not delinquent in the payment of any tax administered by the Department of Revenue unless the individual or other entity is contesting, in accordance with the procedure established by the appropriate Revenue Act, its liability for the tax or the amount of the tax. Making a false statement voids the contract and allows the Department to recover all amounts paid to the individual or entity under the contract in a civil action.

2. **Bid-Rigging or Bid Rotating**. The bidder or contractor or subcontractor, respectively, certifies that it is not barred from contracting with the Department by reason of a violation of either 720 ILCS 5/33E-3 or 720 ILCS 5/33E-4.

   A violation of section 33E-3 would be represented by a conviction of the crime of bid-rigging which, in addition to Class 3 felony sentencing, provides that any person convicted of this offense, or any similar offense of any state or the United States which contains the same elements as this offense shall be barred for 5 years from the date of conviction from contracting with any unit of State or local government. No corporation shall be barred from contracting with any unit of State or local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent on behalf of the corporation.

   A violation of Section 33E-4 would be represented by a conviction of the crime of bid-rotating which, in addition to Class 2 felony sentencing, provides that any person convicted of this offense or any similar offense of any state or the United States which contains the same elements as this offense shall be permanently barred from contracting with any unit of State of Local government. No corporation shall be barred from contracting with any unit of State or Local government as a result of a conviction under this Section of any employee or agent of such corporation if the employee so convicted is no longer employed by the corporation and: (1) it has been finally adjudicated not guilty or (2) if it demonstrates to the governmental entity with which it seeks to contract and that entity finds that the commission of the offense was neither authorized, requested, commanded, nor performed by a director, officer or a high managerial agent on behalf of the corporation.

3. **Bribery.** The bidder or contractor or subcontractor, respectively, certifies that, it has not been convicted of bribery or attempting to bribe an officer or employee of the State of Illinois or any unit of local government, nor has the firm made an admission of guilt of such conduct which is a matter or record, nor has an official, agent, or employee of the firm committed bribery or attempted bribery on behalf of the firm and pursuant to the direction or authorization of a responsible official of the firm.

4. **Interim Suspension or Suspension.** The bidder or contractor or subcontractor, respectively, certifies that it is not currently under a suspension as defined in Subpart I of Title 44 Subtitle A Chapter III Part 6 of the Illinois Administrative code. Furthermore, if suspended prior to completion of this work, the contract or contracts executed for the completion of this work may be canceled.

Local Public Agency	County	Section Number	Route(s) (Street/Road Name)
Tazewell County	Tazewell	21-00000-06-MG	Highway Office and Shop Buildi

SIGNATURES

(If an individual)

Bidder Signature & Date

Business Address

City | State | Zip Code

(If a partnership)

Firm Name

Signature & Date

Title

Business Address

City | State | Zip Code

Insert the Names and Addresses of all Partners

(If a corporation)

Corporate Name

Signature & Date

Title

Business Address

City | State | Zip Code

Insert Names of Officers

President

Secretary

Attest:

Secretary

Treasurer

Illinois Department of Transportation

Schedule of Prices

Contractor's Name

Contractor's Address | City | State | Zip Code

Local Public Agency: Tazewell County | County: Tazewell | Section Number: 21-00000-06-MG

Route(s) (Street/Road Name): Highway Office and Shop Building Renovations

Schedule for Multiple Bids

Combination Letter	Section Included in Combinations	Total

Schedule for Single Bid

(For complete information covering these items, see plans and specifications.)

Item Number	Items	Unit	Quantity	Unit Price	Total
	Office Renovations	1	L. Sum		
	Shop Renovations	1	L. Sum		
				Bidder's Total Proposal	

1. Each pay item should have a unit price and a total price.
2. If no total price is shown or if there is a discrepancy between the product of the unit price multiplied by the quantity, the unit price shall govern.
3. If a unit price is omitted, the total price will be divided by the quantity in order to establish a unit price.
4. A bid may be declared unacceptable if neither a unit price or total price is shown.

Illinois Department of Transportation

Local Public Agency Proposal Bid Bond

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

WE, _____ as PRINCIPAL, and

_____ as SURETY, are held jointly, severally and firmly bound unto the above Local Public Agency (hereafter referred to as "LPA") in the penal sum of 5% of the total bid price, or for the amount specified in the proposal documents in effect on the date of invitation for bids, whichever is the lesser sum. We bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly pay to the LPA this sum under the conditions of this instrument.

WHEREAS THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH that, the said PRINCIPAL is submitting a written proposal to the LPA acting through its awarding authority for the construction of the work designated as the above section.

THEREFORE if the proposal is accepted and a contract awarded to the PRINCIPAL by the LPA for the above designated section and the PRINCIPAL shall within fifteen (15) days after award enter into a formal contract, furnish surety guaranteeing the faithful performance of the work, and furnish evidence of the required insurance coverage, all as provided in the "Standard Specifications for Road and Bridge Construction" and applicable Supplemental Specifications, then this obligation shall become void; otherwise it shall remain in full force and effect.

IN THE EVENT the LPA determines the PRINCIPAL has failed to enter into a formal contract in compliance with any requirements set forth in the preceding paragraph, then the LPA acting through its awarding authority shall immediately be entitled to recover the full penal sum set out above, together with all court costs, all attorney fees, and any other expense of recovery.

IN TESTIMONY WHEREOF, the said PRINCIPAL and the said SURETY have caused this instrument to be signed by their respective officers this _____ (Day) of _____ (Month and Year)

Principal

Company Name	Company Name
Signature & Date	Signature & Date
By:	By:
Title	Title

(If Principal is a joint venture of two or more contractors, the company names, and authorized signatures of each contractor must be affixed.)

Surety

Name of Surety	Signature of Attorney-in-Fact Signature & Date
	By:

STATE OF IL

COUNTY OF

I _____ , a Notary Public in and for said county do hereby certify that

_____

(Insert names of individuals signing on behalf of PRINCIPAL & SURETY)

who are each personally known to me to be the same persons whose names are subscribed to the foregoing instrument on behalf of PRINCIPAL and SURETY, appeared before me this day in person and acknowledged respectively, that they signed and delivered said instruments as their free and voluntary act for the uses and purposes therein set forth.

Given under my hand and notarial seal this _____ (Day) day of _____ (Month and Year) .

Notary Public Signature & Date

(SEAL, if required by the LPA)

Date commission expires _____

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

ELECTRONIC BID BOND

☐ **Electronic bid bond is allowed (box must be checked by LPA if electronic bid bond is allowed)**

The Principal may submit an electronic bid bond, in lieu of completing the above section of the Proposal Bid Bond Form. By providing an electronic bid bond ID code and signing below, the Principal is ensuring the identified electronic bid bond has been executed and the Principal and Surety are firmly bound unto the LPA under the conditions of the bid bond as shown above. (If PRINCIPAL is a joint venture of two or more contractors, an electronic bid bond ID code, company/Bidder name title and date must be affixed for each contractor in the venture.)

Electronic Bid Bond ID Code

Company/Bidder Name

Signature & Date

Title

Illinois Department of Transportation

Apprenticeship and Training Program Certification

Local Public Agency	County	Street Name/Road Name	Section Number
Tazewell County	Tazewell	Office & Shop Renovations	21-00000-06-MG

All contractors are required to complete the following certification

☒ For this contract proposal or for all bidding groups in this deliver and install proposal.

☐ For the following deliver and install bidding groups in this material proposal.

Illinois Department of Transportation policy, adopted in accordance with the provisions of the Illinois Highway Code, requires this contract to be awarded to the lowest responsive and responsible bidder. The award decision is subject to approval by the Department. In addition to all other responsibility factors, this contract or deliver and install proposal requires all bidders and all bidder's subcontractors to disclose participation in apprenticeship or training programs that are (1) approved by and registered with the United States Department of Labor's Bureau of Apprenticeship and Training, and (2) applicable to the work of the above indicated proposals or groups. Therefore, all bidders are required to complete the following certification:

1. Except as provided in paragraph 4 below, the undersigned bidder certifies that it is a participant, either as an individual or as part of a group program, in an approved apprenticeship or training program applicable to each type of work or craft that the bidder will perform with its own employees.

2. The undersigned bidder further certifies, for work to be performed by subcontract, that each of its subcontractors either (A) is, at the time of such bid, participating in an approved, applicable apprenticeship or training program; or (B) will, prior to commencement of performance of work pursuant to this contract, establish participation in an approved apprenticeship or training program applicable to the work of the subcontract.

3. The undersigned bidder, by inclusion in the list in the space below, certifies the official name of each program sponsor holding the Certificate of Registration for all of the types of work or crafts in which the bidder is a participant and that will be performed with the bidder's employees. Types of work or craft that will be subcontracted shall be included and listed as subcontract work. The list shall also indicate any type of work or craft job category for which there is no applicable apprenticeship or training program available.

4. Except for any work identified above, if any bidder or subcontractor shall perform all or part of the work of the contract or deliver and install proposal solely by individual owners, partners or members and not by employees to whom the payment of prevailing rates of wages would be required, check the following box, and identify the owner/operator workforces and positions of ownership. ☐

The requirements of this certification and disclosure are a material part of the contract, and the contractor shall require this certification provision to be included in all approved subcontracts. The bidder is responsible for making a complete report and shall make certain that each type of work or craft job category that will be utilized on the project is accounted for and listed. The Department at any time before or afterward may require the production of a copy of each applicable Certificate of Registration issued by the United States Department of Labor evidencing such participation by the contractor and any or all of its subcontractors. In order to fulfill the participation requirement, it shall not be necessary that any applicable program sponsor be currently taking or that it will take applications for apprenticeship, training or employment during the performance of the work of this contract or deliver and install proposal.

Bidder

Signature & Date

Title

Address	City	State	Zip Code

Illinois Department of Transportation

Affidavit of Illinois Business Office

Local Public Agency	County	Street Name/Road Name	Section Number
Tazewell County	Tazewell	Office & Shop Renovations	21-00000-06-MG

I, _____ of _____ , _____ ,
Name of Affiant | City of Affiant | State of Affiant

being first duly sworn upon oath, state as follows:

1. That I am the _____ of _____ .
Officer or Position | Bidder

2. That I have personal knowledge of the facts herein stated.

3. That, if selected under the proposal described above, _____ , will maintain a business office in the
Bidder

State of Illinois, which will be located in _____ County, Illinois.
County

4. That this business office will serve as the primary place of employment for any persons employed in the construction contemplated by this proposal.

5. That this Affidavit is given as a requirement of state law as provided in Section 30-22(8) of the Illinois Procurement Code.

Signature & Date

Print Name of Affiant

Notary Public

State of IL

County _____

Signed (or subscribed or attested) before me on _____ by
(date)

_____ , authorized agent(s) of
(name/s of person/s)

_____ .
Bidder

Notary Public Signature & Date

(SEAL)

My commission expires _____

INDEX
FOR
SUPPLEMENTAL SPECIFICATIONS
AND RECURRING SPECIAL PROVISIONS

Adopted January 1, 2024

This index contains a listing of SUPPLEMENTAL SPECIFICATIONS and frequently used RECURRING SPECIAL PROVISIONS.

SUPPLEMENTAL SPECIFICATIONS

Illinois Department of Transportation

Check Sheet for Recurring Special Provisions

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

☐ **Check this box for lettings prior to 01/01/2024.**

The Following Recurring Special Provisions Indicated By An "X" Are Applicable To This Contract And Are Included By Reference:

Recurring Special Provisions

Check Sheet #			Page No.
1	☐	Additional State Requirements for Federal-Aid Construction Contracts	59
2	☐	Subletting of Contracts (Federal-Aid Contracts)	62
3	☐	EEO	63
4	☐	Specific EEO Responsibilities Non Federal-Aid Contracts	73
5	☐	Required Provisions - State Contracts	78
6	☐	Asbestos Bearing Pad Removal	84
7	☐	Asbestos Waterproofing Membrane and Asbestos HMA Surface Removal	85
8	☐	Temporary Stream Crossings and In-Stream Work Pads	86
9	☐	Construction Layout Stakes	87
10	☐	Use of Geotextile Fabric for Railroad Crossing	90
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13	☐	Pavement and Shoulder Resurfacing	98
14	☐	Patching with Hot-Mix Asphalt Overlay Removal	99
15	☐	Polymer Concrete	101
16	☐	Reserved	103
17	☐	Bicycle Racks	104
18	☐	Temporary Portable Bridge Traffic Signals	106
19	☐	Nighttime Inspection of Roadway Lighting	108
20	☐	English Substitution of Metric Bolts	109
21	☐	Calcium Chloride Accelerator for Portland Cement Concrete	110
22	☐	Quality Control of Concrete Mixtures at the Plant	111
23	☒	Quality Control/Quality Assurance of Concrete Mixtures	119
24	☐	Reserved	135
25	☐	Reserved	136
26	☐	Temporary Raised Pavement Markers	137
27	☐	Restoring Bridge Approach Pavements Using High-Density Foam	138
28	☐	Portland Cement Concrete Inlay or Overlay	141
29	☐	Portland Cement Concrete Partial Depth Hot-Mix Asphalt Patching	145
30	☐	Longitudinal Joint and Crack Patching	148
31	☐	Concrete Mix Design - Department Provided	150
32	☐	Station Numbers in Pavements or Overlays	151

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

The Following Local Roads And Streets Recurring Special Provisions Indicated By An "X" Are Applicable To This Contract And Are Included By Reference:

Local Roads And Streets Recurring Special Provisions

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LRS 2	☐	Furnished Excavation	154
LRS 3	☒	Work Zone Traffic Control Surveillance	155
LRS 4	☒	Flaggers in Work Zones	156
LRS 5	☒	Contract Claims	157
LRS 6	☒	Bidding Requirements and Conditions for Contract Proposals	158
LRS 7	☐	Bidding Requirements and Conditions for Material Proposals	164
LRS 8		**Reserved**	170
LRS 9	☐	Bituminous Surface Treatments	171
LRS 10		**Reserved**	175
LRS 11	☒	Employment Practices	176
LRS 12	☒	Wages of Employees on Public Works	178
LRS 13	☒	Selection of Labor	180
LRS 14	☐	Paving Brick and Concrete Paver Pavements and Sidewalks	181
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Illinois Department of Transportation

Special Provisions

Local Public Agency	County	Section Number
Tazewell County	Tazewell	21-00000-06-MG

The following Special Provision supplement the "Standard Specifications for Road and Bridge Construction", adopted January 1, 2022, the latest edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways", and the "Manual of Test Procedures of Materials" in effect on the date of invitation of bids, and the Supplemental Specification and Recurring Special Provisions indicated on the Check Sheet included here in which apply to and govern the construction of the above named section, and in case of conflict with any parts, or parts of said Specifications, the said Special Provisions shall take precedence and shall govern.

The following documents are Special Provisions of this contract:

DIVISION 01 – GENERAL REQUIREMENTS
01 11 00 Summary of Work 2 pages
01 26 00 Contract Modification Procedures 3 pages
01 29 00 Payment Procedures 6 pages
01 32 00 Construction Progress Documentation 8 pages
01 33 00 Submittal Procedures 5 pages
01 60 00 Product Requirements 3 pages
01 62 00 Product Options and Substitutions 3 pages
01 73 00 Execution 11 pages
01 77 00 Project Closeout 4 pages

DIVISION 02 – SITEWORK
02 41 00 Site Demolition 5 pages
02 41 19 Selective Demolition 5 pages

DIVISION 03 – CONCRETE
03 05 00 Common Work Results for Concrete 5 pages
03 11 00 Concrete Forming 6 pages
03 15 00 Concrete Accessories 7 pages
03 20 00 Concrete Reinforcing 6 pages
03 31 00 Structural Concrete 18 pages
03 39 00 Concrete Curing 6 pages

DIVISION 04 – MASONRY
04 01 20.64 Brick Masonry Repointing 9 pages
04 20 00 Unit Masonry 10 pages

DIVISION 05 – METALS
05 52 00 Metal Railings 4 pages

DIVISON 07 – THERMAL AND MOISTURE PROTECTION
07 19 00 Water Repellents 5 pages
07 21 00 Thermal Insulation 4 pages
07 92 00 Joint Sealants 8 pages

DIVISION 08 – OPENINGS
08 11 13 Hollow Meal Doors and Frames 12 pages
08 36 13 Sectional Doors 8 pages
08 52 00 Aluminum Windows 4 pages
08 71 00 Door Hardware 7 pages

08 80 00 Glazing 12 pages

DIVISION 09 – FINISHES
09 22 16 Non-Structural Metal Framing 7 pages
09 29 00 Gypsum Board 4 pages
09 30 13 Ceramic Tiling 4 pages
09 51 10 Acoustical Panel Ceilings 4 pages
09 65 13 Resilient Base and Accessories 5 pages
09 65 19 Resilient Tile Flooring 4 pages
09 91 00 Painting 18 pages

DIVISION 10 – SPECIALTIES
10 21 13.13 Metal Toilet Compartments 4 pages
10 51 13 Metal Lockers 5 pages
10 80 10 Toilet and Shower Accessories 3 pages

DIVISION 13 – SPECIAL CONSTRUCTION
13 34 19 Metal Building Systems 11 pages

DIVISION 22 – PLUMBING
22 05 00 Basic Plumbing Materials and Methods 11 pages
22 05 29 Sleeves, Supports, Hangers, Anchors, and Seals 11 pages
22 07 19 Piping Insulation 6 pages
22 10 00 Plumbing 15 pages
22 10 19 Plumbing Specialties 4 pages
22 11 23 Gas Piping 6 pages
22 40 00 Plumbing Fixtures 8 pages

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING
23 05 00 Basic Mechanical Materials and Methods 11 pages
23 05 29 Sleeves, Supports, Hangers, Anchors, and Seals 13 pages
23 05 48 Mechanical Sound, Vibration and Seismic Control 4 pages
23 05 93 Air Systems Testing, Adjusting, and Balancing 4 pages
23 07 13 Duct Insulation 5 pages
23 07 18 Refrigerant Piping Insulation 4 pages
23 23 00 Refrigerant Piping and Specialties 6 pages
23 31 13 Ductwork 7 pages
23 33 00 Ductwork Accessories 8 pages
23 34 00 Power Ventilators 4 pages
23 37 00 Air Inlets and Outlets 5 pages
23 62 00 Air Cooled Condensing Units 4 pages
23 73 01 Furnaces 4 pages

DIVISION 26 – ELECTRICAL
26 01 26 Testing Electrical Systems 3 pages
26 05 00 Common Work Results for Electrical 5 pages
26 05 05 Electrical Demolition 3 pages
26 05 19 Low-Voltage Electrical Power Conductors and Cables 6 pages
26 05 26 Grounding and Bonding for Electrical Systems 4 pages
26 05 29 Hangers and Supports for Electrical Systems 3 pages
26 05 33 Raceway and Boxes for Electrical Systems 10 pages

26 05 53 Identification for Electrical Systems 3 pages
26 27 26 Wiring Devices 6 pages
26 50 00 Interior Lighting 5 pages

DIVISION 31 – EARTHWORK
31 22 13 Rough Grading 3 pages
31 23 16 Excavation 5 pages
31 23 23 Fill 7 pages
31 25 00 Erosion Control 3 pages
31 32 00 Soil Stabilization 4 pages

DIVISION 32 – EXTERIOR IMPROVEMENTS
32 11 23 Aggregate Base Courses 3 pages
32 13 13 Concrete Paving 3 pages

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The Work consists of renovating the existing Shop Building. The work shall consist of the following:

a. MFT-funded work: Replacing the existing wall & roof panels, new overhead doors, man doors and windows & brick repointing.
b. Non-MFT funded work: Interior renovation work, including installing a new restroom, remodeling the existing restroom, new floor and ceiling finishes, mezzanine railing modifications.

1.02 CONTRACTS

A. All work for the project will be performed under a single General Contractor, including general mechanical, electrical, plumbing and site work, where basis of payment is a unified bid.

B. Work shall be performed under the direction of the Contractor. Certain items of work may be indicated to be "not-in-contract", “In future phase” or "by others". In these cases the Contractor shall coordinate with such other contractors or persons as the Owner may direct to achieve final installation or construction.

C. Unless otherwise indicated, the performance of all Work described in the Contract Documents shall be the responsibility of the Contractor.

1.03 PROJECT INFORMATION

A. Project location: 21308 IL Rt. 9, Tremont, Illinois 61568

B. Owner’s Representative:

1. Mr. Dan Parr: (309) 925-5532

1.04 PROJECT TIME SCHEDULE

A. Work of the project shall start within ten calendar days after issuance of a Notice to Proceed.

1.05 WORK SCHEDULING AND COORDINATION

A. The Contractor shall schedule all construction activities as required to achieve an orderly and expeditious prosecution of all work covered by the Contract

Documents.

B. The Contractor, in cooperation with its subcontractors, shall prepare and adhere to a comprehensive Construction Schedule designed to complete the total project within the time specified in Article 1.4, and prepared in accordance with the SPECIAL CONDITIONS.

C. Delivery hours for construction materials delivery shall occur after 7:00 A.M. and before 5:00 P.M. Monday through Friday, unless written exception is provided by the OWNER.

D. Construction activities shall not interfere with the public or traffic, local or through traffic, and other private operations, particularly during lunch time hours and rush hours. All roads will be maintained in an “open for to the Public” mode, when not included in the Work or before construction activities being. The Contractor shall provide all appropriate signage to alert the public of access, entry restrictions and egress changes.

1.06 MANAGEMENT OF CONTRACTOR'S FORCES

A. The Contractor shall designate a superintendent who shall represent the Contractor on the jobsite. Directions given to this superintendent shall be as binding as if given to the Contractor

B. Manage, schedule and supervise the Work to meet the construction schedule.

C. Directions from the Owner to the Contractor will only be through the Engineer Contractor shall not accept direction from nor negotiate changes with the Owner.

END OF SECTION 01 11 00

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Architect / Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1. Work Change Proposal Requests issued by Architect / Engineer are not instructions either to stop work in progress or to execute the proposed change.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect / Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect / Engineer are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 15 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity

relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect / Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.

5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect / Engineer will issue a Change Order for signatures of Owner and Contractor.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect / Engineer may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: Architect / Engineer may issue a Work Change Directive. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 01 26 00 – Contract Modification Procedures
2. Section 01 32 00 – Construction Progress Documentation

C. **Owner Funding:**

1. **The Office Building improvements shown on Sheets 2 to 19 of the Drawings will be paid at the Lump Sum price for Office Renovations identified on the Proposal Schedule of Prices.**

2. **The Shop Building improvements shown on Sheets 20 to 34 of the Drawings will be paid at the Lump Sum price for Shop Renovations identified on the Proposal Schedule of Prices.**

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect / Engineer at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
3. Sub-schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Owner's name.
    c. Owner's Project number.
    d. Name of Architect.
    e. Architect's Project number.
    f. Contractor's name and address.
    g. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
        1) Labor.
        2) Materials.
        3) Equipment.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five (5) percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site.

5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect / Engineer and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

1. Submit draft copy of Application for Payment seven (7) days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect / Engineer and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect / Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit one (1) signed and notarized original copy of each Application for Payment to Architect / Engineer which shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.

5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.

12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1 Section 01 33 00 – Submittal Procedures for submitting schedules and reports.
2. Section 01 40 00 – Quality Requirements for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

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

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

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

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

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

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity

description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at bi-weekly intervals.

H. Material Location Reports: Submit at bi-weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of discovery of differing conditions.

K. Unusual Event Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's / Engineer's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 – Project Management and Coordination. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages, interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures.

9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontractors, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice of Award final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than twenty (20) days, unless specifically allowed by Architect / Engineer.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Regulatory agency approvals.
f. Punch list.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities in-

clude, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 – Submittal Procedures in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's / Engineer's administrative procedures necessary for certification of Substantial Completion.
5. Punch List and Final Completion: Include not more than fifteen (15) days for completion of punch list items and final completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 – Summary. Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 - Summary. Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordinate list below with work restrictions listed in Section 01 10 00 – Summary.
    b. Coordination with existing construction.
    c. Limitations of continued occupancies.
    d. Uninterruptible services.
    e. Partial occupancy before Substantial Completion.
    f. Use of premises restrictions.
    g. Provisions for future construction.
    h. Seasonal variations.
    i. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.

c. Purchases.
d. Mockups.
e. Fabrication.
f. Sample testing.
g. Deliveries.
h. Installation.
i. Inspections.
j. Adjusting.
k. Curing.
l. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide the following:

a. Structural completion.
b. Temporary enclosure of space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one (1) day before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentages for each activity.

I. Recovery Schedule: When periodic update indicates the Work is fourteen (14) or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1.8 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within fifteen (15) days of date established for the Notice of Award. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in ten (10) percent increments within time bar.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.

7. Accidents.
8. Meetings and significant decisions.
9. Unusual events.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial completions and occupancies.
18. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 2 – PRODUCTS (Not Used)

PART 3 – PRODUCTS (Not Used)

END OF SECTION 01 32 00

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment and services necessary or incidental to the completion of all submittals in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 62 00: Product Options and Substitutions
B. Sections of the specification applicable to the work included in this section.

1.03 WORK NOT INCLUDED

A. Submittals not required will not be reviewed by the ENGINEER.

B. The Contractor may require its subcontractors to provide drawings, setting diagrams and similar information to help coordinate the Work, but such data may be required for Envision and Project Goal Documentation but may not be reviewed by the ENGINEER for correctness or compliance with the design intent.

1.04 QUALITY ASSURANCE

A. Coordination of Submittals:

1. The Contractor shall promptly prepare a schedule for timely submittal and processing of shop drawings required by the Contract Documents. The schedule shall be distributed to the ENGINEER, the Owner and the subcontractors. This schedule shall list all required submittals by specification section number and shall indicate the week the submittal will occur. Schedule shall be submitted no later than ten days prior to the first application for payment.

2. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.

3. Verify that each item and the submittal for it conform in all respects with the specified requirements.

4. The General Contractor shall note deviations in the shop drawings from the Contract Documents, informing the ENGINEER in writing, or by markup of the shop drawings, of each deviation at the time of submission. The General Contractor shall inform the ENGINEER in writing or on

resubmitted shop drawings, of any revisions other than those requested by the ENGINEER on previous submittals.

5. The Contractor shall verify and coordinate all field dimensions before shop fabrication of materials, items, products or equipment.

6. By affixing the Contractor's signature and stamp to each submittal, certify that this coordination has been performed. Submittals not signed and stamped by the Contractor will be immediately returned, unreviewed, to the Contractor by the ENGINEER.

7. The ENGINEER shall notify the Contractor in writing if certain shop drawings must be held for correlation with shop drawings of related items.

8. Neither the Contractor nor the ENGINEER shall initiate changes to the Contract Documents by making corrections to the shop drawings.

B. Substitutions:

1. Substitutions will be considered as outlined in Section 01 62 00 - Product Options and Substitutions.

PART 2 - PRODUCTS

2.01 SHOP DRAWINGS

A. Scale and measurements: Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work.

B. Types of prints required:

1. Submit Shop Drawings in the form of one digital copy, with all sheets included in one commonly read file, or four blackline prints of each sheet.

C. Review comments of the ENGINEER will be shown on the digital copy or blackline prints when it is returned to the Contractor. The Contractor may make and distribute such copies as are required for his purposes.

2.02 MANUFACTURER'S LITERATURE

A. Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly show which portions of the contents is being submitted for review.

B. Submit the number of copies which are required to be returned, plus three copies

which will be retained by the ENGINEER and ENGINEER's consultants.2.3 SAMPLES

A. Provide sample or samples identical to the precise article proposed to be provided. Identify as described under "Identification of Submittals" below.

B. Number of samples required:

1. Unless otherwise specified, submit samples in the quantity, which is required to be returned, plus two, which will be retained by the ENGINEER.

2. By prearrangement in specific cases, a single sample may be submitted for review and, when approved, be installed in the Work at a location agreed upon by the ENGINEER. These cases are indicated in each technical specification.

2.04 COLORS AND PATTERNS

A. Unless the precise color and pattern is specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts or physical samples to the ENGINEER for selection.

2.05 SPECIALTY PRODUCT INSTALLATION AND PERSONNEL

A. Project Personnel Experience (Specialized experience and technical competence). The Contractor shall demonstrate the relevant experience of key project personnel when indicated by the Technical Specifications through Preconstruction Submittals before commencing any portion of the Work.

1. Biographical data shall include the following:

a. Name of individual.
b. Company employed by.
c. Company position title.
d. Years with the company.
e. Position that the individual will hold in regard to this contract/project team, description of duties and what percentage of the individual’s time would be committed to the project during the construction and establishment phases.
f. An indication of which other individuals submitted under Project Personnel Experience this individual has worked with and the project they worked on together.

2. Experience and Certification data shall include the following:

a. Describe work experience with projects that included technical and specialized material and product installations such as surfaces, drainage, soils, and plantings. Include the company (by name) they worked for when involved in the project.
b. An indication of which what the individuals responsibility was for the technical and specialized project, indicated above.
c. Describe job related educational experience including degrees, certificates etc. and granting institutions or certifying bodies.

PART 3 - EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS

A. Number all submittals with the Specification Section, and a transmittal number suffix, which proceed consecutively for each separate submittal.

1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.

2. On resubmittals, cite the original submittal number for reference.

B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.

C. On at least the first page of each submittal, and elsewhere as required for positive identification, show the submittal and section number in which the item was included.

D. Maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. Make the submittal log available to the ENGINEER for his review upon request.

E. All submittals shall repeat the identification shown on the Contract Drawings and shall be identified by specification section number.

3.02 GROUPING OF SUBMITTALS

A. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking each item when it is received.

3.03 TIMING OF SUBMITTALS

A. Make submittals far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible

revisions and resubmittals, and for placing orders and securing delivery.

B. In scheduling, allow ten working days for review by the ENGINEER following his receipt of the submittal.

3.04 ENGINEER'S REVIEW

A. Review by the ENGINEER does not relieve the Contractor from responsibility for errors, which may exist in the submitted data. The ENGINEER will not review quantities required.

B. Revisions:

1. Make revisions required by the ENGINEER.

2. If the Contractor considers any required revision to be a change, he shall notify the ENGINEER.

3. Make only those revisions directed or approved by the ENGINEER.

END OF SECTION 01 33 00

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Material and equipment incorporated into the work shall:

1. Conform to applicable specifications and standards.

2. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.

3. Manufacturer and fabricated products:

a) Design, fabricate and assemble in accord with the best engineering and shop practices.

b) Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

c) Two or more items of the same kind shall be identical, by the same manufacturer.

d) Products shall be suitable for service conditions.

e) Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

f) To the extent possible without impacting cost or schedule, products shall be manufactured in a location of regional proximity and with local sourced and or recycled materials as indicated in Section 01820: Envision and Sustainable Project Goals

g) To the extent possible without impacting cost or schedule, products shall be manufactured from recycled content and this content shall be documented as indicated in Section 01820: Envision and Sustainable Project Goals.

h) To the extent possible without impacting cost or schedule, products shall be provided by manufactures that employ sustainable, environmentally friendly, and/or responsible practices as indicated in Section 01820: Envision and

4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions and Special Conditions

B. Section 01 33 00: Submittal Procedures

C. Section 01 62 00: Product Options and Substitutions

D. Section 01 77 00: Project Closeout

1.03 MANUFACTURER'S INSTRUCTIONS

A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to ENGINEER.

1. Maintain one set of complete instructions at the jobsite during installation and until completion.

2. Maintain manufacturers Operations and Maintenance instructions and contact information until completion, at which point instructions will be submitted to Owner.

B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

2. Do not proceed with work without clear instructions.

C. Perform work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accord with construction schedules and coordinate to avoid conflict with work and conditions at the site.

1. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.

3. To minimize waste generated on site, return packaging not recommended for storage and protection of materials after delivery to manufacturer.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.05 STORAGE AND PROTECTION

A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Store products subject to damage by the elements in weathertight enclosures.

2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Exterior Storage:

1. Store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. Cover with impervious sheet coverings. Provide adequate ventilation to avoid condensation.

2. Store loose granular materials in a well-drained area on solid surfaces or utilizing other measures to prevent mixing with foreign matter.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

D. Protection After Installation:

1. Provide substantial coverings as necessary to protect installed products from damage due to traffic and subsequent construction operations. Remove when no longer needed.

END OF SECTION 01 60 00

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SECTION 01 62 00
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section describes product options available to the Contractor and procedures for securing approval of proposed substitutions.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions

B. Section 01 33 00: Submittal Procedures

C. Section 01 60 00: Product Requirements

1.03 PRODUCT OPTIONS

A. The Contract is based on standards of quality established in the Contract Documents.

1. In agreeing to the terms and conditions of the Contract, the Contractor accepts responsibility for verifying in advance that the specified products will be available; and agrees to place orders for all required materials in such a timely manner as is needed to meet his agreed construction schedule.

2. Neither the Owner nor the Engineer has agreed to the substitution of any materials or methods called for in the Contract Documents, except as they may specifically otherwise state in writing.

B. Where materials and/or methods are specified by naming one single manufacturer and/or model number, without stating that equal products will be considered, only the material and/or method so named is approved for incorporation into the work.

1. Should the Contractor demonstrate to the approval of the Engineer that a specified material or method, ordered in a timely manner, will not be available in time for incorporation into this work, the Contractor Shall propose substitute materials and/or methods to the Engineer with documentation sufficient to help the Engineer determine suitability of the proposed substitution.

C. Where materials and/or methods are specified by name and/or model number, followed by the words "or equal", "equal approved by the Engineer", "equal approved by Engineer prior to Bidding", or the like:

1. The material and/or method specified by name establishes the required standard of quality.

2. Materials and/or methods proposed by the Contractor to be used in lieu of materials and/or methods so specified by name shall in all ways equal or exceed the qualities of the named materials and/or methods.

3. Proposed substitutions shall be submitted for approval per the requirements of the General Conditions.

4. Do not assume that materials, equipment or methods proposed for substitution will be approved.

5. Material qualities and manufacturer methods associated with Envision and Sustainable Project Goals will be evaluated as part of the Engineer’s Approval.

6. Approval must be obtained in writing by the Engineer.

7. The decision of the Engineer shall be final.

D. The following products do not require further approval except for interface within the work:

1. Products specified by reference to standard specifications such as ASTM and similar standards.

2. Products specified by manufacturer's name and catalog model number.

1.04 REIMBURSEMENT OF ENGINEER'S COSTS

A. If substitutions, other than those meeting the conditions of Paragraph 1.3.B.1, are proposed to the Engineer after Contract award, the Engineer will record all time used by the Engineer and his consultants in evaluating each such proposed substitution.

B. The Engineer shall bill for reimbursement at a rate two and one-half times the direct cost for all time, plus 10 percent, for all costs related to evaluating the proposed substitution.

C. Upon receipt of the Engineer’s billing, the Contractor shall promptly reimburse the Engineer, whether or not the proposed substitution is approved.

END OF SECTION 01 62 00

SECTION 01 73 00
EXECUTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 01 10 00 – Summary of Work
2. Section 01 33 00 – Submittal Procedures
3. Section 01 77 00 – Project Closeout

1.03 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.04 INFORMATIONAL SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.05 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect / Engineer of locations and details of cutting and await directions from Architect / Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do no cut and patch structural elements in a manner that could change their load-carrying capacity of increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's / Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect / Engineer for the visual and functional performance of in-place materials.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine rough-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes and primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect / Engineer according to requirements in Section 01 31 00 – Project Management and Coordination.

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect / Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect / Engineer when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundation and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect / Engineer.

3.04 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, horizontal control points, and property corners on the plans.

B. Reference Points: Locate existing permanent benchmarks, horizontal control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect / Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect / Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect / Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project Site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 01 77 00 – Closeout Procedures for repairing or removing and replacing defective Work.

3.06 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 – Summary.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum

size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished areas into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional costs until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface or uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a watertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 – Temporary Facilities and Controls.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.08 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 – Quality Requirements."

3.09 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 77 00
PROJECT CLOSEOUT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall furnish all labor, materials, equipment and services necessary or incidental to the completion of all project closeout work in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions and Special Conditions

PART 2 - EXECUTION

2.01 RECORD DOCUMENTS

A. The Contractor shall maintain at the site for the Owner one record copy of:
   1. Drawings
   2. Specifications
   3. Addenda
   4. Change Orders and other modifications to the contract
   5. Engineer's Field Orders or written instructions
   6. Approved Shop Drawings, Product Data and Samples

B. Maintenance of documents and samples:
   1. The Contractor shall store documents and samples in Contractor's field office apart from documents used for construction.
      a) Provide files and racks for storage of documents.
      b) Provide locked cabinets or secure storage space for storage of samples.
   2. The Contractor shall maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
   3. The Contractor shall make documents and samples available at all times for inspection by Engineer and Owner's representative.

C. Recording
   1. The Contractor shall label each document "PROJECT RECORD" in neat large printed letters.
   2. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
   3. Drawings: Legibly mark to record actual construction.
      a) Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

b) Field changes of dimension and detail.
c) Changes made by Field Order or by Change Order.
d) Details not on original Contract Drawings.

4. Specifications: Legibly mark to record actual installed material if the specified item has been substituted with a Mandatory Alternate as permitted by Section 01620 - Product Options and Substitutions.

D. Reproducible record drawings:
1. At the time of Substantial Completion, the Contractor shall provide a complete set of digital files, in readily transmitted and readable format, made from the original Contract Drawings, including Engineering, structural, mechanical, fire protection and electrical drawings.
2. The Contractor shall carefully, accurately and completely transfer all markings, additions, deletions, and revisions from the Project Record Drawings to digital files, in readily transmitted and readable format, with each marking clearly distinguishable from the original information.
3. The Contractor shall label each digital reproducible media "PROJECT RECORD" with an Indication of discipline, systems, or scope contained in neat large printed letters, and date as of the Date of Substantial Completion.

E. Submittals
1. At Contract close-out, the Contractor shall deliver Record Documents, including digital reproducible files, to Engineer for the Owner.
2. Accompany submittal with transmittal letter in duplicate, containing:
a) Date.
b) Project title and number.
c) Contractor's name and address.
d) Title, file name, and number of each Record Document.
e) Signature of Contractor or his authorized representative.
f) Warranty Certificates and Manufacturer or Provider’s Contact info

2.02 OPERATIONS AND MAINTENANCE DATA

A. The Contractor shall provide media containing digital files, in readily transmitted and readable format, of all operating instructions and parts list for all operating general, mechanical, electrical, fire protection, and control equipment and other manufactured items.
1. The operating instructions shall integrate each piece of equipment in any one system into a numbered step-by-step sequence of operation.
2. The maintenance manuals shall include an exploded view and a parts list, with all component parts numbered, of each item of operating or expendable equipment.
3. Electrical manuals shall also contain an approved copy of each shop drawing.

B. Additional operating instruction and maintenance manuals' requirements are specified in their respective sections or divisions.

C. The Contractor shall include copies of all required manufacturer's or installers warranties.

D. Operating and maintenance data submittals shall be reviewed and accepted by the Engineer prior to processing final application for payment.

E. Each subcontractor shall train the maintenance personnel designated by the Owner in the operation and maintenance of all equipment installed by the subcontractor.

2.03 PUNCHLIST

A. The purpose of a punchlist is to assure the Owner and the Engineer that all incorrect work shall be corrected with reasonable promptness and in accordance with the Contract Documents and to provide an incentive to complete the work promptly to ensure prompt payment in full.

1. It is not the purpose of a punchlist to provide the Contractor with a 'work list' of items to be completed.
2. The work also includes submittals and documents for recording the Envision and Sustainable Project Goals for use in green rating certification and with future projects or work on site. It is an added purpose of the punchlist to ensure all installed products and materials are fully represented in the Documentation Notebook and submittal records.

B. The Contractor shall carefully check the work as it is being performed.

C. Unsatisfactory work shall be corrected immediately and not be permitted to remain and become a part of the punchlist.

D. Prior to, but no later than this Substantial Completion inspection, dates shall be established for equipment testing and instructional requirements not previously completed or agreed upon.

E. Following the Substantial Completion inspection and preparation of the punchlist, the Contractor shall meet with the Engineer to discuss what is required to before the Work can be accepted as complete. The Contractor shall respond promptly in completing the punchlist work.

F. The Engineer shall advise the Owner on the value of the Work not completed.

G. If the Owner, or a separate contractor installing Owner's equipment or furnishings, damages work which has been satisfactorily completed, the Owner bears the responsibility to repair such damaged work.

1. If the Owner wishes to have the Contractor repair such damaged Work or perform maintenance work not called for in the Contract, the Contractor shall be eligible for additional compensation for such work.

END OF SECTION 01 77 00

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SECTION 02 41 00
SITE DEMOLITION

PART 1 GENERAL

1.1 WORK INCLUDES

A. Demolition of structures, paving, and utilities.

B. Filling voids created as a result of removals or demolition.

1.2 RELATED WORK

A. Specified Elsewhere:

1. Section 31 10 00 – Site Clearing
2. Section 31 23 16 – Excavation
3. Section 31 23 23 – Fill

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and runoff control.

B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Do not close or obstruct public or private roadways, sidewalks, or fire hydrants without appropriate permits or written authorization.

E. Conform to applicable regulatory procedures when hazardous or contaminated materials are discovered.

1.4 REFERENCES

A. Conform to the applicable portions of Sections 440 and 501 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.

1.5 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.6 PROJECT CONDITIONS

A. Record existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

B. Structures to be demolished will be discontinued in use and vacated prior to start of work.

C. Owner assumes no responsibility for condition of structures to be demolished.

D. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

E. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.

F. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

G. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with demolition.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Fill material shall be as specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide, erect, and maintain erosion control devices, temporary barriers, and security devices at locations indicated on Construction Drawings.

B. Verify utilities have been disconnected and capped before starting selective demolition operations.

C. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage to existing items to remain caused by demolition operations.

D. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.

E. Before starting, establish location and extent of underground utilities occurring in work area. Contact Joint Utility Locating Information for Excavators (J.U.L.I.E.) (800) 892-0123 or all other utility companies on the project site which are not members of this system, including the Owner.

F. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.

G. Notify adjacent property owners of work that may affect their property, potential noise, utility outages, or other disruptions. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property. Coordinate notice with Owner.

3.2 GENERAL DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures or pavements to remain.

B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed by authority.

C. Conduct operations with minimum of interference to public or private access. Maintain ingress and egress at all times as noted on the drawings.

D. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.

E. Comply with governing regulations pertaining to environmental protection.

F. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.3 DEMOLITION

A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.

B. Disconnect and cap or remove utilities to be abandoned as shown on the drawings.

C. Remove structures, piping, and appurtenances as shown.

D. Demolish paving, curbs and remaining structures completely and remove from site using methods as required to complete work within limitations of governing regulations. Small structures may be removed intact when acceptable to Owner and authorities having jurisdiction.

E. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.

F. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2-feet or more below proposed subgrade to permit moisture drainage. Remove slabs-on-grade and below grade construction within 2-feet of proposed subgrade.

3.4 FILLING BASEMENTS AND VOIDS

A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand free from debris, trash, frozen materials, roots, and other organic matter.

B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.

C. Place fill materials in accordance with Section 31 23 23 - Fill unless subsequent excavation for new work is required.

D. Grade surface as shown on plans to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site debris, rubbish, and other materials resulting from demolition operations. Leave areas of work in clean condition.

B. No burning of any material, debris, or trash on-site or off-site will be allowed, except when allowed by appropriate governing authority and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.

C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions before selective demolition.

END OF SECTION 02 41 00

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract, including all Exhibits and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled, including existing brick masonry for reuse in wall openings and vehicle guardrails.
4. Work associated with lead-based paint.

1.03 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.04 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site with owner to review and document items being salvaged for reuse.

1.05 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.

B. Schedule of selective demolition activities with starting and ending dates for each activity.

C. Pre-demolition photographs or video.

D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

E. Provide Disposal Documentation as required by Owner's Construction Contract Exhibit E Disposal Documentation.

1.06 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials (Asbestos): Known suspect Asbestos Containing Material (ACM) has not been removed from the existing structure/elements to be demolished for building operational purposes and must be removed by the Contractor under the Construction Contract. These items include flooring materials. It is not expected that additional ACM will be encountered in the Work.

1. The Contractor is responsible for removal and disposal of the existing ACM as required by the Contract Documents.
2. The Contractor shall follow all ACM removal and disposal laws, requirements, and guidelines, including but not limited to, those of the Illinois Department of Public Health, the Illinois Environmental Protection Agency, and the Authority Having Jurisdiction.
3. If additional materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Additional hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange utility service shutdowns and service equipment removals with utility companies.
2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

3.03 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or

collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.04 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 3 hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Salvage a quantity of existing brick masonry to reuse for infill of openings in existing brick masonry walls, as shown on drawings.
2. Clean salvaged items.
3. Store items in a secure area until reuse.
4. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Protect items from damage during transport and storage.
3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

F. Burning: Do not burn demolished materials.

G. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 05 00
COMMON WORK RESULTS FOR CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Temporary shoring of existing structure and pipes.
   2. Protection and finishing of concrete surfaces and reinforcement steel associated with concrete removal.
   3. Removal and satisfactory disposal of damaged, spalled, and unsound concrete foundations, walls, slabs, and/or existing pipe at locations shown in the plans and designated by the Engineer.
   4. Replacement of the removed material with new concrete and/or modified concrete patching material, including cleaning exposed reinforcing steel, drilling and grouting dowels for supporting and fastening additional reinforcement if needed, applying a chemical bonding agent; constructing the necessary form work, placing, consolidating and finishing the replacement concrete, forming joints and curing the repaired areas.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 45 00 – Quality Requirements
   3. Section 03 11 00 – Concrete Forming
   4. Section 03 20 00 – Concrete Reinforcing
   5. Section 03 31 00 – Structural Concrete
   6. Section 03 39 00 – Concrete Curing

C. References:
   1. ACI 301-16 – Specifications for Structural Concrete.
   2. ASTM C932 – Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
   3. ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
   4. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.

1.03 DEFINITIONS

A. (RESERVED)

1.04 SUBMITTALS

A. Submit under the provisions of Division 01 – Section 01 33 00 – Submittal Procedures.

B. Refer to Section 03 31 00 for product data, material certifications, design mixtures, and concrete mix properties required for submittal.

C. Product Data: Submit data on finishing materials

1.05 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

1. Maintain one copy of document on site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in accordance with requirements set forth by the Engineer and product manufacturer.

B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 - PRODUCTS

1.07 EQUIPMENT

A. The equipment used shall be subject to approval of the Engineer.

1.08 CONCRETE MATERIALS

A. Refer to Section 03 31 00 for concrete materials.

1.09 ADMIXTURES

A. Refer to Section 03 31 00 for admixtures.

1.10 RELATED MATERIALS

A. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

1.11 REPAIR MATERIALS

A. Refer to Section 03 31 00 for repair materials.

1.12 CONCRETE MIX

A. Concrete mix for concrete repair shall be Mix Design A, as specified in Section 03 31 00, with a maximum coarse aggregate size of 1/2 inch.

1. Concrete mix for concrete repair shall include fiber reinforcement at a dosage rate of 1 Lb/C.Y., or as specified by manufacturer.

B. Contractor may elect to use manufactured repair material for repair areas that are less than 15 square feet. Manufactured repair material shall be from BASF, SIKA, or Engineer approved equal. All manufactured patching materials that the Contractor intends to use must be applied as recommended by the material manufacturer and submitted to the Engineer under the provisions of Section 01 33 00 of the Specifications for approval.

1.13 STEEL REINFORCEMENT

A. Refer to Section 03 20 00.

1.14 FIBER REINFORCEMENT

A. Refer to Section 03 20 00.

1.15 FINISHING MATERIALS

A. Concrete Repair Mortar: Trowel-grade, microsilica and ASTM 1059 latex-modified, cement-based, non-sag repair mortar.

PART 3 - EXECUTION

1.16 INSPECTION

A. The Engineer will identify the areas of unsound concrete to be removed. The depth of removal shall be to sound concrete as determined by the Engineer. The perimeter of the removal shall be saw-cut to a depth of 2" or to top of the existing reinforcing steel, whichever is less. Removal outside the areas authorized by the Engineer will not be measured for payment. Existing concrete shall be removed by methods approved by the Engineer.

1.17 PREPARATION

A. Concrete removal work shall not begin until prior construction sequences indicated on the drawings are completed.

B. The Contractor shall furnish all equipment, material and labor required to temporarily support existing structure and pipes.

C. Any temporary support systems necessary to complete the work shall be in place and accepted by the Engineer prior to excavation and concrete removal work.

1.18 PROTECTION

A. The Contractor shall furnish all equipment, material and labor required to protect concrete surfaces and reinforcement steel.

B. Concrete shall be removed in such a manner as to leave the remaining structure and all attached structures and equipment undamaged. Any damage to the remaining structure or attached structures or equipment shall be repaired by the Contractor as directed by the Engineer at the Contractor's expense.

C. The Contractor shall take precautions to prevent concrete removal debris from entering the plant process system.

1.19 REMOVAL

A. (RESERVED)

1.20 REPAIR AND PATCHING

A. (RESERVED)

1.21 FINISH

A. The Contractor shall furnish all equipment, material and labor required to finish concrete surfaces.

B. All newly exposed concrete surfaces, which are to receive new concrete or finish, shall be blast-cleaned.

C. Where concrete surfaces are not to receive new concrete, limits of concrete removal shall extend 1/2 inch beyond final dimensions. Surfaces shall then be built up with 1/2 inch concrete repair mortar to final dimensions.

D. Apply finish to concrete surfaces in accordance with material manufacturer's preparation and application recommendations.

1.22 DISPOSAL

A. The Contractor shall furnish all equipment and labor required to dispose of the removed concrete and reinforcement.

B. All concrete and non-salvaged reinforcement bars removed by the Contractor shall be disposed of off-site by the Contractor at the Contractor's expense in accordance with the Project Specifications.

C. Dispose of wastewater employed in cutting, washing, and rinsing of concrete surfaces in a manner such that the wastewater does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area.

END OF SECTION 03 05 00

SECTION 03 11 00
CONCRETE FORMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes concrete formwork, shoring, bracing, and anchoring for cast-in-place concrete as shown on the drawings and as herein specified for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Elevated slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.
   8. Concrete sidewalks.
   9. Entrance slabs.
   10. Miscellaneous items requiring forms.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 03 15 00 – Concrete Accessories
   3. Section 03 20 00 – Concrete Reinforcing
   4. Section 03 31 00 – Structural Concrete
   5. Section 07 26 00 – Vapor Retarders

C. References:
   1. ACI 117-10 – Specification for Tolerances for Concrete Construction and Materials.
   2. ACI 301-16 – Specifications for Structural Concrete.
   3. AISC 303-10 – Code of Standard Practice for Steel Buildings and Bridges.
   4. ASTM D4397 – Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
   5. ASTM E1643 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

1.03 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.04 SUBMITTALS

A. Submit under the provisions of Division 01 - Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of product.

C. Formwork shop drawings: Prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structures in accordance with ACI 301 if different than that shown on plans.

1. Location of construction joints is subject to approval of the Engineer.

E. Qualification Data: For installer and manufacturer of forms.

1.05 QUALITY ASSURANCE

A. Construct and erect concrete formwork in accordance with ACI 301.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver form materials in manufacturer's packaging with installation instructions.

B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.07 SYSTEM DESCRIPTION

A. Design and construct formwork, shoring and bracing such that resultant concrete conforms to shapes, lines, and dimensions shown in the contract documents.

PART 2 - PRODUCTS

1.08 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints in formwork.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 31 00, and as follows:
      a. Plywood, metal, or other approved panel materials.
      b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         i. Structural 1, B-B or better; mill oiled and edge sealed.

B. 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.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.
   1. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

1.09 RELATED MATERIALS

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

B. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

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. Contractor shall verify compatibility of form release agent selected with coating specified here-in.
   2. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   3. Products: Subject to compliance with requirements, provide one of the products specified.
      a. Dayton Superior Construction Chemicals - Magic Kote
      b. Lambert Corporation – Form Release Gold
      c. Euclid Chemical Co. – Formshield Pure
      d. Or Engineer approved equal.
   4. 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.

a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
c. Ties shall be removed after forms are removed and holes shall then be filled with mortar that matches adjacent surface.
d. Provide stainless steel form ties for exterior surfaces exposed to view.

e. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

1.10 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

1.11 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until structure can support such loads. Load supporting formwork shall remain in place until concrete has reached 75% of specified minimum 28-day compressive strength.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Concrete surfaces exposed to view shall conform to Surface Finish 3.0. All other as-cast finishes shall conform to Surface Finish-2.0 as specified in ACI 301.

D. Construct forms tight enough to prevent loss of concrete mortar.
1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
1. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyway, reglet, recesses, formwork, and other accessories, for easy removal.

F. Do not use rust-stained steel form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
2. Use strike-off templates or compacting-type screeds.

H. Chamfer exterior corners and edges of permanently exposed concrete as indicated on drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Engineer prior to forming openings not indicated on Drawings.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement, anchoring devices and embedded items. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes, which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

M. Earth forms, except for footings, not permitted.

N. Provide temporary ports in formwork to facilitate cleaning and inspection.
1. Locate openings at bottom of forms to allow flushing water to drain.
2. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

1.12 INSERTS, EMBEDDED PARTS AND OPENINGS

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

B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.

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

D. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances of AISC 303.
3. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
4. Clean embedded items immediately prior to concrete placement.

1.13 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, 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 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces.
   2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

D. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

1.14 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

END OF SECTION 03 11 00

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes reinforcing steel bars, welded wire fabric and accessories for cast-in-place concrete.

B. Related Sections
1. Section 01 33 00 – Submittal Procedures.
2. Section 03 11 00 – Concrete Forming.
3. Section 03 31 00 – Structural Concrete.

C. Reference to Standards
1. ACI 117-10 – Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301-16 – Specifications for Structural Concrete.
3. ACI SP-066 - Detailing Manual.
4. ANSI/ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
5. ASTM A615 – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
6. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
7. ASTM A775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
8. ASTM A884 – Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
9. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
10. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
11. ASTM D3963 – Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Steel Reinforcing Bars.
12. AWS D1.4 – Structural Welding Code – Reinforcing Steel.
13. CRSI - Concrete Reinforcing Steel Institute - Manual of Standard Practice.

1.03 DEFINITIONS

A. (RESERVED)

1.04 SUBMITTALS

A. Submit under the provisions of Division 01 - Section 01 33 00 – Submittal Procedures.

B. Product Data: For the Following:
   1. Each type of steel reinforcement.
   2. Epoxy repair coating.
   3. Zinc repair material.
   4. Bar supports.
   5. Mechanical splice couplers.
   6. Structural thermal break insulated connection system.

C. Steel Reinforcement Shop Drawings:
   1. Placing drawings that detail fabrication, bending, and placement.
   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.

D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
   1. Location of construction joints is subject to approval of the Engineer.

E. Qualification Data: For installer and manufacturer of reinforcement.

F. Material Certificates: For each of the following, signed by manufacturers:
   1. Steel reinforcement and accessories.
   2. Fiber reinforcement.

G. Material Test Reports: For the following, from a qualified testing agency:
   1. Steel Reinforcement:
      a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706.
   2. Mechanical splice couplers.

H. Welder's Certificates: Submit under provisions Division 01 – General Requirements, Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualifications within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI Manual of Standard Practice, ACI 117, and ACI 301.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."

C. Maintain one copy of each document on site.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 COORDINATION

A. Coordinate work under provisions of Division 01 – General Requirements.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

1.08 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

C. Low-Alloy Steel Reinforcing Bars: ASTM A706, deformed.

D. Epoxy-Coated Reinforcing Bars:
   1. Steel Bars: ASTM A 615, Grade 60, deformed.
   2. Epoxy Coating: ASTM A 775 with less than 2 percent damaged coating in each 12-inch bar length.

E. Plain-Steel Welded Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

F. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A coated, Type 1, plain steel.

1.09 REINFORCEMENT ACCESSORIES

A. Steel Tie Wire: ASTM A1064, annealed steel, Minimum 16 gage.

B. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

C. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated.

D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM D 3963 and ASTM A775.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

b. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

1.10 FABRICATION

A. Fabricate concrete reinforcing in accordance with ACI 117.

B. Locate reinforcing splices not indicated on drawings at point of minimum stress.

1.11 FIBER REINFORCEMENT

A. (RESERVED)

PART 3 - EXECUTION

1.12 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

1.13 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Accurately position, support, and secure reinforcement against displacement. Reinforcement shall be tied at a minimum of 50 percent of the bar intersections.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, no less than one bar diameter, or not less than 1 1/3 times the size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with Drawings.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. 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.

G. 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.

H. Accommodate placement of formed openings.

I. Wall reinforcement shall not be placed in the work until one side of the wall forms has been erected, aligned and braced. As the wall reinforcement is placed, it shall be secured to the wall form with the proper clearance between the steel and forms.

J. Slab reinforcement shall be supported by manufactured steel bolsters only. Concrete half-bricks may be permitted only in slab on grade or footing construction.

K. Where walls or other items are shown as built integrally with other sections, but are placed as separate pours, keys and dowels shall be provided. Dowels shall be same size and at same spacing as reinforcing, unless noted otherwise.

L. Provide 4 x 4 - W 4.0 x W 4.0 electrically welded wire fabric, ASTM A185 reinforcing in all concrete slabs on ground unless shown otherwise.

M. Provide corner bars of same size and spacing as main reinforcement at all intersections and corners, unless noted otherwise.

N. Where openings occur in walls or slabs, and unless otherwise noted on the plans, provide two (2) #5 bars at all sides and extending at least 2 feet beyond corners and two (2) #5 bars at least 4 feet long diagonally across each re-entrant corner.

O. The Contractor shall give 24 hour notice to the Engineer for inspection of the reinforcing prior to the placement of the concrete.

P. The reinforcing for the concrete placement shall be completed and inspected before ordering concrete.

1.14 INSTALLATION TOLERANCES

A. Comply with ACI 117.

1.15 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Division 01 – General Requirements.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.
3. Steel-reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 31 00
STRUCTURAL CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. All cast-in-place concrete including, but not limited to floors, slabs on grade, foundation walls, supported slabs, beams and columns.
2. Control, expansion, and contraction joint devices associated with concrete work.
3. Equipment pads and manhole slabs.

B. Related Sections:

1. Section 01 33 00 – Submittal Procedures
2. Section 03 11 00 – Concrete Forming
3. Section 03 15 00 – Concrete Accessories
4. Section 03 20 00 – Concrete Reinforcing
5. Section 03 39 00 – Concrete Curing
6. Section 07 26 00 – Vapor Retarders
7. Section 26 05 33 – Raceway and Boxes
8. Section 31 23 00 – Excavation and Fill

C. References:

1. ACI 117-10 – Specification for Tolerances for Concrete Construction and Materials
2. ACI 301-16 – Specifications for Structural Concrete
3. ACI 305.1-14 – Specification for Hot Weather Concreting
4. ACI 306.1-90 – Standard Specification for Cold Weather Concreting
5. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
6. ASTM C33 – Standard Specification for Concrete Aggregates
7. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
8. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
9. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
10. ASTM C94 – Standard Specification for Ready-Mixed Concrete

11. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
12. ASTM C150 – Standard Specification for Portland Cement
13. ASTM C157 – Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
14. ASTM C172 – Standard Practice of Sampling Freshly Mixed Concrete
15. ASTM C219 – Standard Terminology Relating to Hydraulic Cement
16. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
17. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete
18. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
19. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
20. ASTM C845 – Standard Specification for Expansive Hydraulic Cement
21. ASTM C881 – Standard Specification for Epoxy-Resin Base Bonding Systems for Concrete
22. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
23. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
24. ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
25. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
26. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
27. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete
28. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures
29. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
30. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness
31. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
32. ASTM E1155 – Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.04 PREINSTALLATION MEETINGS

A. Pre-placement Conference: Conduct conference a minimum of 15 days prior to placement of concrete at project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   e. Special concrete finish subcontractor
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.05 SUBMITTALS

A. Submit under the provisions of Division 01 - Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit data for each type of product including, but not limited to, joint devices, attachment accessories, admixtures, form release agents and bonding agent.

C. Qualification Data: For Installer, Manufacturer, and Testing Agency.

D. Material Certifications: For each item listed, submit information indicated.

1. Coarse and Fine Aggregate
   a. Producer Name.
   b. Quarry Location.
   c. Contact Person and Phone Number.
   d. Material Test Reports: From a qualified testing agency, indicating compliance with requirements.
2. Cement
   a. Mill Test Report.
   b. Producer Name and Location.
3. Water
   a. Specify Potable Water Source.

E. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, use of additional admixtures, Project conditions, weather, test results, or other circumstances warrant adjustments. Design Mixtures shall be reviewed according to the provisions of ACI 301.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

F. Concrete Mix Properties:

1. Mix Design
   a. Cementitious Materials (Lbs./C.Y.)
   b. Fine Aggregate (Lbs./C.Y.)
   c. Coarse Aggregate (Lbs./C.Y.)
   d. Water (Lbs./C.Y.)
   e. Admixtures.
2. Slump.
3. Air Content.

G. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

H. Minutes of pre-placement conference.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301

1. Maintain one copy of document on site.

B. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

C. 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."
2. Engineer reserves the right to reject Manufacturer at any time and to require Contractor to obtain different supplier.

D. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.07 PROJECT RECORD DOCUMENTS

A. Contractor shall accurately record actual locations of embedded utilities and components which are concealed from view.

1.08 COORDINATION

A. Coordinate Work under provisions of Division 01 – General Requirements.

PART 2 - PRODUCTS

1.09 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type II. Supplement with the following:
   a. Expansive Cement: ASTM C845, Type K for use in Mix B only.
   b. Fly Ash: ASTM C 618, Class F.
   c. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum size of coarse aggregate shall be in accordance with guidelines listed below:

Max. Aggregate Size	Type of Structure
1/2 inch	Concrete Toppings and Concrete Repair
3/4 inch	Mud Slabs, Stairs and Steps, Columns, Beams, Elevated Slabs, Flowable Fill
1 inch	Grade Beams, Equipment Pads, Slabs on Grade, Interior and Exterior Tank Walls, All Other Structures
1-1/2 inch	Caissons, Piles and Piers, Footings

D. Fine Aggregate: ASTM C 33, Free of materials with deleterious reactivity to alkali in cement.

E. Water: ASTM C 94 and potable.

1.10 ADMIXTURES

A. When required or permitted, admixtures shall conform to requirements specified below. Use of one or more admixtures in concrete shall be approved by Engineer prior to its use at job site.

B. Air-Entraining Admixture: ASTM C 260.

C. Chemical Admixtures: 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 calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Accelerating Admixture: ASTM C 494, Type C.
4. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
8. Shrinkage Reducing Admixture: ASTM C 494, Type S; Maximum Length Change, tested in accordance with ASTM C 157, of 0.030%.

D. Field Service: When requested, the Contractor shall arrange to have a qualified concrete technician employed by manufacturer be available to assist in proportioning concrete materials for optimum use, to advise on proper use of admixture and adjustment of concrete mix proportions to meet job site and climatic conditions.

1.11 FLOOR AND SLAB TREATMENTS

A. (Reserved)

1.12 LIQUID FLOOR TREATMENTS

A. (Reserved)

1.13 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, 1/2 inch thick (unless shown otherwise).

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Latex Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Sealant and Primer: As specified in Section 07 92 00 – Joint Sealants.

1.14 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than design f'c (psi) of concrete substrate at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than design f'c (psi) of concrete substrate at 28 days when tested according to ASTM C 109.

1.15 CONCRETE MIXTURES, GENERAL

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.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

1.16 CONCRETE MIXTURES FOR BUILDING AND TANK ELEMENTS

A. Mix Design A: Proportion normal-weight concrete mixture for all parts of Work as follows:
1. Minimum Compressive Strength: 2500 psi at 7 days, 4500 psi at 28 days
2. Maximum Water-Cementitious Materials Ratio: 0.42
3. Cementitious material: Type II required, fly ash optional
4. Slump: 4 inches; 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture
5. Air Content:

Max. Aggregate Size	Air Content (percent)
1/2 inch	7 ± 1.5
3/4 inch	6 ± 1.5
1 inch	6 ± 1.5
1-1/2 inch	5.5 ± 1.5

a. Interior floor slabs located indoors not subjected to exposure conditions shall not contain entrained air.

1.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 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.
2. In addition to batch ticket information required by ASTM C 94, the following shall be provided:

a. Concrete Design Strength.
b. Type and amount of cement.
c. Class and amount of coal fly ash, or raw or calcined natural pozzolans, if present.
d. Class and amount of ground granulated blast furnace slag, if present.
e. Type and amount of silica fume, if present.
f. Type and amount of admixtures.
g. Type and amount of fiber reinforcement, if present.
h. Maximum size of aggregate.
i. Amount of water added at job site shall be noted on ticket. No water is to be added at job site unless acceptable to Engineer.

3. One copy of delivery ticket shall be furnished to Engineer at time truck arrives at job site.

PART 3 - EXECUTION

1.18 INSPECTION

A. Verify site conditions under provisions of Division 01 - General Requirements.

B. Verify requirements for concrete cover over reinforcement have been met.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed and positioned securely.

D. Verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

1.19 PREPARATION

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

B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink or epoxy grout, unless noted otherwise.

C. Contractor shall inform Engineer 24 hours in advance of any concrete pours, indicating location and size of pour by submitting completed pre-pour checklist.

1.20 CONCRETE PLACEMENT

A. Concrete shall be conveyed and placed in conformance with ACI 301. Contractor shall instruct laborers on proper vibration techniques required for each situation.

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 high-range water-reducing admixtures to mixture.

C. Delivery of mixed concrete shall be regulated so that there will not be an interruption of more than 20 minutes duration in placement of concrete. Engineer may waive these requirements if slump and temperature requirements are met without adding water.

D. At beginning of concrete placement, a spare vibrator shall be on job site in addition to vibrators to be used during placement.

E. If electrical power for equipment used in the concrete placement is provided by a portable electric generator, an additional back-up portable electric generator or an alternate reliable electrical source shall be available prior to and during the concrete placement.

F. 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 in accordance with Contract Documents. 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. Concrete placed in vertical forms shall be placed in lifts of not more than 2 feet which shall be kept practically level.
   2. Chutes shall extend as nearly as practicable to point of deposit. Concrete shall not be dropped more than 6 feet. For walls or column placements in excess of 6 feet vertical height, tremie shall be used in placing concrete. If reinforcing steel or formwork is such that tremie cannot be used, method of placement shall be approved by Engineer.
   3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

G. 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.

5. 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.

H. Pumping Concrete: Comply with ACI 301 and as follows.
1. Selection of pipe diameter for pumping shall be such that smallest inside diameter is no less than 4 inches or 3 times nominal maximum size coarse aggregate, whichever is greater.
2. Pumping lines shall be lubricated with minimum of 1 cubic yard of grout prior to pumping regular mix through lines.
3. Contractor shall show sufficient evidence prior to use of pump that mix is pumpable. This shall be accomplished by submittal, in accordance with Specification Section 01 33 00, of a certification from supplier that mix has performed satisfactorily on previous jobs of similar nature or by performing full scale field test for pumpability with line height and other variables being identical (or nearly so) to that of actual placing conditions.

I. 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 for three successive days, 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.

J. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1 and as follows:
1. 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. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.21 FINISHING FORMED SURFACES

A. Defects in new concrete such as rock pockets and tie holes shall be repaired when forms are removed. Grout used for repair shall contain a bonding admixture conforming to ASTM C1059, Type II. Use admixture according to manufacturer's written instructions. This shall be done for all surface finishes of formed concrete surfaces.
1. Snap-off form ties shall be removed to a point 1" beneath surface of concrete and resulting depression shall be carefully pointed with grout.

2. Removable form tie holes shall be plugged with X-Plug by Sika Greenstreak, or Engineer approved equal, and packed with grout.

B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched.

1. Apply to concrete surfaces to be covered by earth fill.

C. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to exposed concrete surfaces and submerged surfaces.

D. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete surfaces indicated on plans:

1. Wet down the entire area and fill all air pockets, voids and other depressions with grout to produce a smooth dense surface free from pits and other irregularities. Thoroughly scrub into the wetted surface a mortar mixture consisting of 1 part well graded sand passing the No. 30 sieve, 1 part portland cement and a sufficient quantity of a bonding admixture (described previously) to produce a workable mixture. Scrubbing shall be accomplished by use of a rubber or wood float following by finishing with a cork float or a light brush. The resulting surface shall be true and uniform, with no discernible thickness of mortar on the surface.
2. Finish shall extend a minimum of one foot below final grade.

E. 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.

F. Edges and corners of structures, which are exposed in the completed structures, shall be chamfered 3/4 inch, unless noted otherwise.

1.22 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 301 recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to be covered with fill material and surfaces to receive concrete toppings.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high

spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with built-up or membrane roofing.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view and to clarifier floor grout.

E. Broom Finish: In lieu of final troweling, apply a broom finish to exterior concrete slabs, sidewalks, platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Edges and corners of structures, which are exposed in the completed structures, shall be chamfered 3/4 inch, unless noted otherwise. Edges of walks and slabs on grade shall be finished with an edging tool.

G. Walks and slabs on grade shall have contraction joints scored in the concrete to control cracking. The spacing of the scored joints shall be equal to the width of the walk or slab unless otherwise specified or noted on the plans.

1.23 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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. 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.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

1.24 JOINT FILLERS (RESERVED)

1.25 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when directed by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water and/or bonding agent for handling and placing.

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 to solid concrete. Limit cut depth to 3/4 inch. 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 Engineer.

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. 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.
5. 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 Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

1.26 PLANT QUALITY CONTROL

A. Sufficient testing shall be done by the supplier to assure the quality and consistency of the mix produced. The field tests are not to be used as a gauge of this quality.

1.27 FIELD QUALITY CONTROL

A. Provide under provisions of Division 01 - General Requirements.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. 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 delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

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. Compression Test Specimens: ASTM C 31.
    a. Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
    b. Where the Contractor intends to remove load supporting forms (when conditions permit), cast and field cure one set of four standard cylinder specimens for each composite sample. Field curing shall continue up to within four hours prior to laboratory testing. The Contractor shall be responsible for the safe field storage of the concrete cylinders during the field curing process.
6. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and two specimens at 28 days. The fourth cylinder shall be held for testing as a check cylinder.
    a. A 28 day compressive-strength test shall be the average compressive strength of two specimens obtained from same composite sample.
7. Test results shall be submitted in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain:
    a. Project identification name and number
    b. Name of concrete testing and inspecting agency
    c. Date of concrete placement
    d. Date of compressive strength test
    e. Location of concrete batch in Work
    f. Design compressive strength at 28 days
    g. Mix design designation
    h. Slump of concrete
    i. Temperature of concrete at placement
    j. Percent air entrained
    k. Number of specimens tested
    l. Compressive breaking strength
    m. Type of break for both 7- and 28-day tests
8. 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.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

a. If compressive strength requirements are not met, steps shall be taken to increase average of subsequent strength test results. Engineer shall have right to order a change in proportions of mix for remaining work. Engineer shall also have right to require conditions of temperature and moisture necessary to secure required strength.

b. If any strength test of laboratory-cured cylinders falls below specified compressive strength by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection or curing, steps shall be taken to assure that the load-carrying capacity of structure is not jeopardized.

c. If likelihood of low-strength concrete is confirmed and computations indicate that load-carrying capacity may have been significantly reduced, tests of cores drilled from area in question may be required in accordance with ASTM C 42. In such cases, three cores shall be taken for each strength test more than 500 psi below specified compressive strength. If concrete in structure will be dry under service condition, cores shall be air dried (temperature 60° to 80° F., relative humidity less than 60%) for 7 days before test and shall be tested dry. If concrete in structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and be tested wet.

d. Concrete in an area represented by core tests shall be considered structurally adequate if average of three cores is equal to at least 85% of specified compressive strength and if no single core is less than 75% of specified compressive strength. To check testing accuracy, locations represented by erratic core strengths may be retested.

e. If criteria of paragraph (d) are not met, and if structural adequacy remains in doubt, the Engineer may order load tests as outlined in ACI 318 for questionable portion of structure or require other appropriate action.

f. All costs associated with performing analytical investigations, core testing and load testing shall be paid for by Contractor.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

1.28 WATERTIGHTNESS

A. (RESERVED)

END OF SECTION 03 31 00

SECTION 03 39 00
CONCRETE CURING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes initial and final curing, sealing of vertical foundation wall surfaces and exterior concrete flat work and curing, sealing and dust proofing of interior concrete floor slab surfaces.

B. Related Sections:
1. Section 01 33 00 – Submittal Procedures
2. Section 03 31 00 – Structural Concrete

C. References:
1. AASHTO M182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
2. ACI 301-16 – Specifications for Structural Concrete.
3. ACI 305.1-14 – Specification for Hot Weather Concreting.
4. ACI 306.1-90 – Standard Specification for Cold Weather Concreting.
5. ACI 308.1-11 – Standard Specification for Curing Concrete.
6. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
9. ASTM D2103 – Standard Specification for Polyethylene Film and Sheeting.

1.03 DEFINITIONS

A. (RESERVED)

1.04 SUBMITTALS

A. Submit under the provisions of Division 01 - Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on curing compounds, including compatibilities and limitations.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, ACI 305.1, ACI 306.1 and ACI 308.1.
   1. Maintain one copy of each document on site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products under provisions of Division 01 - General Requirements.

B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 - PRODUCTS

1.07 EVAPORATION RETARDER:

A. Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Products: Subject to compliance with requirements, provide one of the products specified:
   1. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
   2. BASF Construction Chemicals - Building Systems; Confilm.
   3. ChemMasters; SprayFilm.
   4. Conspec by Dayton Superior; Aquafilm.
   5. Dayton Superior Corporation; Sure Film (J-74).
   6. Edoco by Dayton Superior; BurkeFilm.
   7. Euclid Chemical Company (The), an RPM company; Eucobar.
   8. Kaufman Products, Inc.; Vapor-Aid.
   9. Lambert Corporation; LAMBCO Skin.
   10. L&M Construction Chemicals, Inc.; E-CON.
   11. Meadows, W. R., Inc.; EVAPRE.
   12. Metalcrete Industries; Waterhold.
   13. Nox-Crete Products Group; MONOFILM.
   14. Sika Corporation; SikaFilm.
   15. SpecChem, LLC; Spec Film.
   16. Symons by Dayton Superior; Finishing Aid.
   17. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
   18. Unitex; PRO-FILM.
   19. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
   20. Or Engineer approved equal.

1.08 ABSORPTIVE COVER:

A. AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

1.09 MOISTURE-RETAINING COVER:

A. ASTM C171, polyethylene film or white burlap-polyethylene sheet.

1.10 WATER:

A. ASTM C94 and potable.

B. Engineer approved equal.

1.11 CLEAR, WATERBORNE, MEMBRANE-FORMING CURING COMPOUND

A. ASTM C309, Type 1, Class B, dissipating
1. Euclid Chemical Company – Kurez DR-100
2. Dayton Superior – Clear Resin Cure J11W
3. BASF – MasterKure 181

1.12 CLEAR, SOLVENT-BORNE, MEMBRANE-FORMING CURING AND SEALING COMPOUND:

A. ASTM C1315, Type 1, Class A.

B. Products: Subject to compliance with requirements, provide one of the products specified.
1. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
2. ChemMasters; Spray-Cure & Seal Plus.
3. Conspec by Dayton Superior; Sealcure 1315.
4. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
5. Edoco by Dayton Superior; Cureseal 1315.
6. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
7. Kaufman Products, Inc.; Sure Cure 25.
8. Lambert Corporation; UV Super Seal.
9. L&M Construction Chemicals, Inc.; Lumiseal Plus.
10. Meadows, W. R., Inc.; CS-309/30.
11. Metalcrete Industries; Seal N Kure 30.
12. Right Pointe; Right Sheen 30.
13. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
14. Or Engineer approved equal.

C. COATING SCHEDULE
1. Exterior & Interior Concrete Foundation Walls: One coat application
2. Exterior Concrete Flatwork: One coat application
3. Interior Concrete Floor Slabs: Two coat application

PART 3 - EXECUTION

1.13 INSPECTION

A. Verify substrate conditions under provisions of Division 01 - General Requirements.

B. Verify that substrate surfaces are ready to be cured.

1.14 CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./hour before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar 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.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven 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.
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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing and Sealing Compound: Apply uniformly to surfaces indicated 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 where indicated. Maintain continuity of coating and repair damage during curing period.

F. Cold Weather Concreting and Curing: Placing and protection of concrete shall be in conformance with ACI 306.1 and shall meet approval of Engineer prior to its use.

1. Contractor shall maintain temperature records of concrete. When concrete is placed, the time, date, weather conditions, outside air temperature and temperature of concrete shall be recorded. Temperatures shall be recorded at several locations (or as directed by Engineer) within enclosures and on concrete surfaces, edges and corners to obtain the range of temperatures. The maximum and minimum temperatures in each 24-hour period shall be recorded using measuring devices embedded in concrete surface or by placing thermometer against surface under temporary cover of thick insulation until a constant temperature is registered.

G. Hot Weather Concreting and Curing: Placing and protection of concrete shall be in conformance with ACI 305.1 and shall meet approval of Engineer prior to its use.

1. Contractor shall conform to ACI 305.1 when following conditions exist:
   a. Any combination of high air temperature, low relative humidity and high wind velocity.
   b. Any combination of rising air temperature and falling relative humidity.
2. Under hot weather conditions, Contractor shall be responsible for making arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or wet covering of light color. Arrangements shall be made in advance of placement and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

1.15 PROTECTION OF FINISHED WORK

A. Protect finished work under provisions Division 01 - General Requirements.

B. Do not permit traffic over unprotected floor surface.

1.16 FINAL ACCEPTANCE OF COMPLETE WORK

A. The work shall be complete in every detail and the finished work approved by the Architect / Engineer and Owner before final acceptance.

END OF SECTION 03 39 00

SECTION 04 01 20.64
BRICK AND STONE MASONRY REPOINTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Repointing brick and stone joints with mortar (Lab Building).
2. Pointing (only) of stone masonry façade with mortar, as specified under Part 3 Execution (Lab Building).

1.03 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa).

1.04 SEQUENCING AND SCHEDULING

A. Order sand and gray Portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site enough quantity to complete Project.

B. Work Sequence: Perform brick masonry repointing work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and permanently point one mortar layer before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Clean masonry.
4. Rake out mortar from joints to be repointed.
5. Point mortar and sealant joints.
6. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
7. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units to match existing. Patch holes in mortar joints according to "Repointing Masonry" Article.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product to be used on the project.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Samples for Initial Selection. For the following:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by 1/2 inch (13 mm) wide, set in aluminum or plastic channels.

a. Have each set contain a close color range of at least three samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

2. Replacement Masonry Units: Submit a sample of 4 replacement bricks to match existing brick masonry units.

3. Sealant materials.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For brick masonry repointing specialist.

1.07 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

1. Field Supervision: Brick masonry repointing specialist firms shall maintain experienced full-time supervisors on Project site during times that brick masonry repointing work is in progress.

B. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches high by 48 inches wide for each type of repointing required, and repoint one of the areas.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

1. Existing Mortar: Test according to ASTM C 1324, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength.
2. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

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

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits, General: Repoint mortar joints only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after pointing.

D. Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repointing brick masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.02 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

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

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

D. Mortar Cement: ASTM C 1329/C 1329M.

E. Mortar Sand: ASTM C 144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color to match existing mortar color.

F. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.03 ACCESSORY MATERIALS

A. Sealant Materials:

1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."

a. Type: Single-component, non-sag urethane sealant.

2. Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.
3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the No. 100 sieve.

B. Joint-Sealant Backing:

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible, joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Masking Tape: Non-staining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.04 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C 270, Proportion Specification, 1 part Portland cement, 1 part lime, and 6 parts sand.

PART 3 EXECUTION

3.01 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below pointing work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.02 MASONRY AND STONE REPOINTING, GENERAL

A. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

3.03 REPOINTING MASONRY AND STONE

A. Rake out and repoint joints to the following extent:

1. All brick masonry, stone sills and stone parapet cap joints in areas indicated.
2. Joints indicated as sealant-filled joints.
3. Do not rake out joints of stone masonry façade. Follow only pointing with mortar procedure in Paragraph 3.03 D. and subsequent specifications.

B. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width, but not less than 3/4 inch (20 mm) or not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

C. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

D. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened

joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

E. Pointing with Sealant: Comply with Section 07 92 00 "Joint Sealants." and as follows:

1. After raking out, keep joints dry and free of mortar and debris.
2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Fill sealant joints with specified joint sealant.

    a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
    b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
    c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

        1) Fill joints to a depth equal to joint width, but not more than 1/2 inch (13 mm) deep or less than 1/4 inch (6 mm) deep.

    d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
    e. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.04 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent non-masonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.06 WATER REPELLANTS

A. Apply water repellant per requirements of Section 07 19 00.

END OF SECTION 04 01 20.64

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete masonry units.
3. Mortar and Grout
4. Reinforcing Steel
5. Masonry Joint Reinforcement
6. Ties and Anchors
8. Miscellaneous Masonry Accessories

1.02 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

1.04 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.05 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high.

1.06 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

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

PART 2 - PRODUCTS

2.01 UNIT MASONRY, GENERAL

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

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.02 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3,250 psi.
2. Density Classification: Normal weight.

2.03 MORTAR AND GROUT MATERIALS

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

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

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

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

E. Aggregate for Mortar: ASTM C 144.

1. For joints less than ¼ inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C 404.

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

H. Water: Potable.

2.04 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Masonry-Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

D. Masonry-Joint Reinforcement for Multi-Wythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

E. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch diameter, hot-dip galvanized carbon steel continuous wire.

2.05 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82, with ASTM A 153, Class B-2 coating.
2. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 1/4-inch-diameter, hot-dip galvanized-steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized-steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch-diameter, hot-dip galvanized-steel wire.

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch thick steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch diameter, hot-dip galvanized-steel wire.

F. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153.

2.06 MISCELLANEOUS MASONRY ACCESSORIES

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

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

2.07 MASONRY CLEANERS

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

2.10 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.

2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

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

D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

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

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

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3,000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

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

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.02 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.03 LAYING MASONRY WALLS

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

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

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

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

3.04 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

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

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.05 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

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

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

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

3.06 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.07 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 5 feet.

3.10 REPAIRING, POINTING, AND CLEANING

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

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
3. Protect adjacent surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 20 00

DIVISION 05 – METALS
Section 05 52 00 - Metal Railings

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract, including all Exhibits and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Steel pipe railings, posts, balusters and fittings.

B. Related Sections:
   1. Section 05 12 00 – Structural Steel Framing
   2. Section 05 50 00 – Metal Fabrications
   3. Section 05 51 00 – Metal Stairs
   4. Section 09 91 00 - Painting

1.03 REFERENCE TO STANDARDS

A. ASTM A53, Grade B, Type S, Schedule 40 - Steel pipe.

B. ASTM A663 – Standard Specifications for Steel Bars.

1.04 DESIGN REQUIREMENTS

A. Comply with ASTM E985 based on the following:
   1. Testing per ASTM E894 and E935.

B. Design, fabricate and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.
   1. Top Rail of Guardrail Systems: Capable of withstanding concentrated load of 200 lb applied at any point and in any direction and capable of withstanding a uniform load of 50 pounds per lineal foot applied horizontally at right angles to the top rail. Concentrated load shall not be assumed to act concurrently with uniform loads.
   2. Handrails Not Serving as Top Rails: Capable of withstanding concentrated load of 200 lb applied at any point and in any direction and capable of withstanding a uniform load of 50 pounds per lineal foot applied horizontally at right angles to the top rail. Concentrated and uniform loads shall not be assumed to act concurrently.
   3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lb applied to one sq. ft. at any point in the system

including panels, intermediate rails, balusters, or other elements composing the infill area. Load shall not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

C. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.05 SUBMITTALS

A. Qualification Data: For Delegated-Design Professional Engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. In addition to product data, submit following:

1. Shop drawings showing railing layout and details of components.
2. Samples of each type of metal finish indicated.
3. Test reports from independent testing laboratory evidencing compliance with ASTM E985.
4. Summary of loads imposed on the supporting structures.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1, “Structural Welding Code – Steel.”

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Pipe and Tube Railings:
   a. Pisor Industries, Inc.
   b. Wagner, R & B, Inc.; a division of the Wagner Companies
   c. Or equal.

2.02 STEEL HANDRAIL SYSTEM

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Pipe: ASTM A53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless otherwise stated in the Drawings or another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A36

2.03 FABRICATION

A. Fit and shop assemble components in largest practical sizes, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate components of same material and finish as fabrication, except where specifically noted otherwise.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

F. Accurately form components to suit stairs and landings to each other and to structure.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

A. Clean steel and concrete surfaces which will be in contact with handrail post assemblies.

3.03 INSTALLATION

A. Set work accurately in location, alignment, and elevation and free from rack.

B. Provide all returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of the railing and wall is 1/4" or less.

C. Comply with manufacturer's recommendations for field connections of handrail and railing members.

D. Anchor posts to metal surfaces with fittings designed for this purpose.

E. Anchor rail ends to masonry and concrete with round flanges connected to rail ends and fastened to wall with post-installed anchors and bolts.

3.04 ERECTION TOLERANCES

A. Deviation from plumb, level and alignment shall not exceed 1 in 500.

3.05 REPAIR

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 00 “Painting”.

END OF SECTION 05 52 00

SECTION 07 19 00
WATER REPELLANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Brick masonry.
2. Natural stone.

B. Related Requirements:

1. Section 04 01 20.64 - Brick and Stone Masonry Repointing

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
3. Include printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of water repellent.

C. Preconstruction Test Reports: For water-repellent-treated substrates.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."

C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.

1. Provide mockups as follows:

a. Use brick repointing mockup.
b. One section of stone panels.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Representative of the Owner specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion or manufacturer's standard if longer.

PART 2 PRODUCTS

2.01 PENETRATING WATER REPELLENTS

A. Silane/Ethel Silicate-Blend, Penetrating Water Repellent: Clear, silane and ethel silicate blend with 600 g/L or less of VOCs.

1. Basis of Design Manufacturer: Subject to compliance with requirements, provide the following or approved equal by Representative of Commissioner:
   a. Prosoco; Siloxane PD
   b. Evonik Industries; BSM 400

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

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

3.02 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Clay Brick Masonry: ASTM D 5703.

2. Natural Stone: ASTM C 1515.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.03 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi-pressure spray with a fan-type spray nozzle roller or brush to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.04 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Contractor will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Owner's Representative.

B. Coverage Test: In the presence of Owner's Representative, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Owner's Representative seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.05 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by the Owner's Representative.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract including all Exhibits, and Divisions 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation, for framed applications.
2. Vapor retarders for framed applications.

1.03 SUBMITTALS

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

B. Product test reports.

C. Research/evaluation reports.

PART 2 - PRODUCTS

2.01 GLASS-FIBER BLANKET INSULATION

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

1. CertainTeed Corporation
2. Guardian Building Products, Inc.
3. Johns Manville
4. Knauf Insulation
5. Owens Corning
6. “or Equal”

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.02 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mil (.15mm) thick, with maximum permeance rating of 0.1 perm (7.5 ng/Pa x s x sq. m).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.02 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

    a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
    b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward interior of construction.
    b. Interior Walls: Set units with facing placed toward areas of high humidity.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.03 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-

retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 07 21 00

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract, including all Exhibits and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes but is not limited to joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal non-traffic surfaces:

a. Construction joints in cast-in-place concrete.
b. Control and expansion joints in Unit Masonry.
c. Perimeter joints between materials listed above and frames of doors, windows and louvers.
d. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces where indicated:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Joints between different materials listed above.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings.
c. Vertical joints on exposed surfaces of interior unit masonry walls and partitions, including structural steel.
d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
e. Miscellaneous plumbing, electrical, mechanical fixtures, equipment and controls at walls and floors.
f. Other joints as indicated.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated herein.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view for approval by the Architect/Engineer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's and General Contractor authorized Installer who is approved for installation of elastomeric sealants required for this project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg. F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Single Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Available Products:

a. Pecora Corporation; 898.
b. Tremco; Tremsil 600.
c. Or equal

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.

C. Single component nonsag Urethane Sealant:

1. Available Products:

a. Sonneborn, Division of ChemRex Inc.; NP 1.
b. Tremco; Vulkem 227.
c. Tremco; Dymonic.
d. Or equal

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.

D. Single component Pourable Urethane Sealant:

1. Available Products:

a. Meadows, W. R., Inc.; POURTHANE.
b. Pecora Corporation; Urexpan NR-200.
c. Sonneborn, Division of ChemRex Inc.; SL 1.
d. Tremco; THC-900.
e. Or equal

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.

2.03 LATEX JOINT SEALANTS (Interior paintable surfaces)

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:

1. Pecora Corporation; AC-20+.
2. Sonneborn, Division of ChemRex Inc.; Sonolac.
3. Tremco; Tremflex 834.
4. Meadows, W. R., Inc
5. Or equal

2.04 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Manufacturer's standard non-sag, paintable, non-staining latex acoustical sealant complying with ASTM C834.

1. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.05 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.06 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such

contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints to satisfaction of the Architect / Engineer.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

A. Exterior vertical and horizontal non-traffic construction joints in cast-in-place concrete.

1. Joint Sealant Single component non-sag urethane sealant.

B. Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.

1. Joint Sealant: Single component pourable urethane sealant.

C. Miscellaneous exterior vertical joints.

1. Joint Sealant: Single component non-sag urethane sealant.

D. Exterior perimeter joints around frames of doors, windows, and louvers.

1. Joint Sealant: Single component non-sag urethane sealant.

E. Control and expansion joints on exposed interior surfaces of exterior walls.

1. Joint Sealant: Single component non-sag urethane sealant.

F. Interior perimeter joints of exterior openings.

1. Joint Sealant: Single component non-sag urethane sealant.

G. Interior expansion, control, contraction, and isolation joints in horizontal traffic surfaces.

1. Joint Sealant: Single component pourable urethane sealant.

H. Vertical joints on exposed surfaces of interior unit masonry, concrete walls, partitions, and steel structure.

1. Joint Sealant: Single component non-sag urethane.

I. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.

1. Joint Sealant: Latex sealant.

J. Perimeter joints between interior wall surfaces and ceiling grids and where shown on drawings.

1. Joint Sealant: Acoustic, non-sag, paintable, non-staining latex.

3.07 FINAL ACCEPTANCE OF COMPLETE WORK

A. The work shall be complete in every detail and the finished work approved by the Engineer and Owner before final acceptance.

END OF SECTION 07 92 00

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Glazing” for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 08 Section "Access Control Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
8. Division 26 "Electrical" Sections for electrical connections including conduit and wiring for door controls and operators installed on frames with factory installed electrical knock out boxes.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Doors Under Specified Pressure Differences Across the Specimens.
11. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
12. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
13. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
14. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
15. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
16. NFRC 102 – Procedure for Measuring the Steady State Thermal Transmittance of Fenestration Systems.
17. NFRC 400 – Procedure for Determining Fenestration Product Air Leakage.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.

8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.

1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:

a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.37, R-Value 2.7, including insulated door, thermal-break frame and threshold.

2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:

a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.06 PROJECT CONDITIONS

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

1.07 COORDINATION

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

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM

processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Steelcraft (S).

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.03 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.

    a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on- center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
    b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
    c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

    1. Design: Flush panel.
    2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

        a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

    3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
    4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
    5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.
2. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

2.04 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) – Thermal Break TQ Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) - CM Series.
b. Curries Company (CU) - M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.06 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.07 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.08 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

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

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

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

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

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.09 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

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

3.02 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 08 11 13

SECTION 08 36 13
SECTIONAL DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes electrically operated sectional doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.02 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

C. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. 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.

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

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.

C. Windborne-Debris Impact Resistance: Provide glazed sectional doors that pass missile-impact and cyclic-pressure tests according to DASMA 115].

D. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 DOOR ASSEMBLY

A. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C.H.I. Overhead Doors.
b. Clopay Building Products.
c. Haas Door.
d. Wayne-Dalton Corp.
e. Raynor

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.

D. Installed R-Value: 15.0 deg F x h x sq. ft./Btu (2.642 K x sq. m/W).

E. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 (Z180) zinc coating.

1. Section Thickness: 2 inches (51 mm).
2. Exterior-Face Surface: Flat.
3. Interior Facing Material: Zinc-coated (galvanized) steel sheet or manufacturer's standard material.

F. Track Configuration: Standard-lift track, unless noted otherwise on schedule.

G. Weather seals: Fitted to bottom and top and around entire perimeter of door.

H. Locking Devices: Equip door with locking device assembly and chain lock keeper.

1. Locking Device Assembly: Cremone type, both jamb sides, locking bars, operable from inside with thumbturn.

I. Manual Door Operator: Chain-hoist operator.

J. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Type: Manufacturer's standard for door requirements.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
4. Motor Exposure: Interior, clean, and dry.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic photoelectric sensor.
7. Control Station: Interior-side mounted.
8. Other Equipment: Portable, radio-control system.

K. Door Finish:

1. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.

3. Finish of Interior Facing Material: Match finish of exterior section face.

2.03 STEEL DOOR SECTIONS

A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet.

1. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet welded to door section. Provide intermediate stiles formed from galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches (1219 mm) apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

E. Provide reinforcement for hardware attachment.

F. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

2.04 TRACK, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.05 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Provide 3-inch-(76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

2.06 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware" and keyed to building keying system.
2. Keys: Two for each cylinder.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.07 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.

C. Cables: Galvanized-steel, multistrand, lifting cables.

D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

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

2.08 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.09 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics: 240V / 1 phase.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.

E. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

F. Control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

2. Provide (2) remote, portable, radio-operated door control units per door.

G. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

PART 3 - EXECUTION

3.01 INSTALLATION

A. 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.

B. Tracks: Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

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

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

E. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

F. 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.

3.02 DEMONSTRATION

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

END OF SECTION 08 36 13

SECTION 08 52 00
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes single-hung aluminum-framed windows.

1.02 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.

B. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient.

1.03 SUBMITTALS

A. Product Data: For each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details

C. Samples: For each exposed finish.

D. Product Schedule: Use same designations indicated on Drawings.

E. Field quality-control test reports.

F. Product test reports.

G. Maintenance data.

1.04 QUALITY ASSURANCE

A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.

B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Five years from date of Substantial Completion.
b. Glazing: 10 years from date of Substantial Completion.
c. Metal Finish: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Kawneer, “OptiQ AA5450” series window, single hung, flat front, with double glazing.

2.02 WINDOW

A. Window Type: Fixed, butt glazed where shown on drawings.

B. Comply with AAMA/WDMA 101/I.S.2/NAFS.

1. Performance Class and Grade: HC 40 minimum.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to NFRC 100.

1. U-Factor: 0.43 Btu/sq. ft. x h x deg F (2.5 W/sq. m x K) or less.

E. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40, determined according to NFRC 200 procedures.

2.03 GLAZING

A. Glass and Glazing Materials: Refer to Division 8 Section 08800 – Glass and Glazing for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.04 FABRICATION

A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

B. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section 08800 – Glass and Glazing and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.05 ALUMINUM FINISHES

A. Aluminum Anodic Finish: Class I, clear anodic coating complying with AAMA 611.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

F. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

G. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

H. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

I. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 52 00

PART 1GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Commercial door hardware.
2. Cylinders for doors specified in other Sections.

B. Related Sections

1. 081113: Hollow Metal Doors and Frames

1.02 SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware, including wiring diagrams.

C. Samples: For each exposed finish.

D. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
b. Content: Include the following information:

i. Identification number, location, hand, fire rating, and material of each door and frame.
ii. Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
iii. Complete designations of every item required for each door or opening including name and manufacturer.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.05 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Coordination of Tornado Resistant Door Hardware: Coordinate the door hardware to be supplied with Tornado Resistant Door as part of a tested opening. Hardware shall closely match specified hardware for other doors.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

1.07 COORDINATION OF SECURITY ACCESS HARDWARE

A. General

1. Contractor shall coordinate the Security Access Hardware with the Steel Door and Frames supplier, Architectural Hardware Consultant / Supplier, Aluminum-Framed Storefronts provider and the Access Control Hardware provider as specified in Division 26
2. Rework to the Steel Doors and Frames necessary to accommodate security access hardware as a result of failure to coordinate the work shall be at contractor's own expense.

PART 2PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

2.02 HINGES, GENERAL

A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Stainless steel, with stainless-steel pin.

C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors.

D. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.03 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Basis of Design: Hager Companies (HAG)

1. (HI-1) BB1279 4.5 x 4.5.

C. Subject to compliance with requirements, other available manufacturers are as follows:

1. Baldwin Hardware Corporation (BH).
2. Bommer Industries, Inc. (BI).
3. Cal-Royal Products, Inc. (CRP).
4. Lawrence Brothers, Inc. (LB).
5. McKinney Products Company; an ASSA ABLOY Group company (MCK).
6. PBB, Inc. (PBB).
7. Stanley Commercial Hardware; Div. of The Stanley Works (STH).

2.04 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Lock Trim/Levers:

1. Product: (LO-1) Best 9K Series, Heavy Duty, US 26D Finish.
2. Lever: 16C

D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.05 LOCK CYLINDERS

A. Standard Lock Cylinders by Best meeting BHMA A156.5**,** Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins**:** seven.

C. Cores: Verify with owner.

2.06 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.

1. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."

1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five master keys.

2.07 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4**,** Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated. Provide drop plate, as required.

1. Manufacturers:

a. LCN 4000 Series, Aluminum Finish (no substitutes)

1. (CL - 1) 4040XP.
2. (CL - 2) 4040XP w/ integral stop.

2.08 KICKPLATES

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by 12" height.

B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch- (1.3-mm-) thick stainless steel.
2. Manufacturers:

a. Basis of Design: Hager Companies, US32D Finish.

i. (KP-1) 194S 10 x 34

b. Subject to compliance with requirements, other manufacturers are as follows:

i. American Floor Products Co., Inc. (AFP).
ii. Baldwin Hardware Corporation (BH).
iii. Burns Manufacturing Incorporated (BM).
iv. Don-Jo Mfg., Inc. (DJO).
v. Hiawatha, Inc. (HIA).
vi. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation (IPC).
vii. IVES Hardware; an Ingersoll-Rand Company (IVS).
viii. Pawling Corporation (PAW).
ix. Rockwood Manufacturing Company (RM).
x. Trimco (TBM).

2.09 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16**,** Grade 1.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Provide silencers for all Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame.

C. Manufacturers:

1. Basis of Design: Hager Companies, US26D.

a. (ST-1) 234W.

2. Subject to compliance with requirements, other manufacturers are as follows:

a. Architectural Builders Hardware Mfg., Inc. (ABH).
b. Baldwin Hardware Corporation (BH).
c. Burns Manufacturing Incorporated (BM).
d. Cal-Royal Products, Inc. (CRP).
e. Don-Jo Mfg., Inc. (DJO).
f. Door Controls International (DCI).
g. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
h. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
i. HES, Inc.; an ASSA ABLOY Group company (HES).
j. Hiawatha, Inc. (HIA).
k. IVES Hardware; an Ingersoll-Rand Company (IVS).
l. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
m. Rockwood Manufacturing Company (RM).
n. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
o. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
p. Trimco (TBM).

2.10 DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

G. Manufacturers

1. Basis of Design: Hager Companies.

a. (GA-1) 891S
b. (SW-1) 750S

2. Subject to compliance with requirements, other manufacturers are as follows:

a. M-D Building Products, Inc. (MD).
b. National Guard Products (NGP).
c. Pemko Manufacturing Co. (PEM).
d. Reese Enterprises (RE).
e. Sealeze; a unit of Jason Incorporated (SEL).
f. Zero International (ZRO).

2.11 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

D. Manufacturers

1. Basis of Design: Hager Companies, Mill Finish.

a. (TH-1) 412S-36 or 72.

2. Subject to compliance with requirements, other manufacturers are as follows:

a. M-D Building Products, Inc. (MD).
b. National Guard Products (NGP).
c. Pemko Manufacturing Co. (PEM).
d. Reese Enterprises (RE).
e. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
f. Sealeze; a unit of Jason Incorporated (SEL).
g. Zero International (ZRO).

2.12 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

C. Finishes: All metallic hardware to have US26D or US32D finish.

PART 3EXECUTION

3.01 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

E. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.02 HARDWARE SCHEDULE

A. Hardware Group #1:

3ea. Butt Hinge
1ea. Latch Set (Passage Function)
1ea. Closer w/ integral stop
1ea. Kickplate

B. Hardware Group #2:

3ea. Butt Hinge
1ea. Latch Set (Privacy Function)
1ea. Closer w/ integral stop
1ea. Kickplate

C. Hardware Group #3

3ea. Butt Hinge
1ea. Latch Set (Entry Function)
1ea. Closer w/ Integral Stop
1ea. Kickplate
1ea. Door Gasketing
1ea. Door Sweep
1ea. Threshold

D. Hardware Group #4

3ea. Butt Hinge
1ea. Latch Set (Passage Function)
1ea. Closer
1ea. Stop
1ea. Kickplate

END OF SECTION 08 71 00

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract, including all Exhibits and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:
   1. Insulating glass for exterior aluminum windows & doors.
   2. Glazing sealants and accessories.

B. Related Requirements:

   1. Section 08 11 13 - Hollow Metal Doors
   2. Section 08 52 00 – Aluminum Windows

1.03 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.04 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.05 SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1. Insulating glass.
2. Tinted glass.
3. Spandrel glass.
4. Laminated glass.

C. Glazing Accessory Samples:

1. For sealants in 12-inch (300-mm) lengths.
2. For decorative film overlay, 12 inch (300 mm) square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For Installer, manufacturers of insulating-glass units with sputter-coated, low-E coatings.

G. Product Certificates: For glass.

H. Product Test Reports: For insulating glass glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

I. Preconstruction adhesion and compatibility test report.

J. Sample Warranties: For special warranties.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer’s Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. PPG
   2. Guardian Industries Corp.; SunGuard.
   3. Oldcastle Building Envelope™.
   4. Pilkington North America.
   5. Or Equal.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

   1. Design Wind Pressures: As indicated on Drawings.

      a. Basic Wind Speed: 90 mph (40 m/s).
      b. Importance Factor: 1.0.
      c. Exposure Category: B.
   2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
   3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Safety Glazing: Where safety glazing is indicated or required, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.

E. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

F. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article.

2.04 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted), Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.05 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.06 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect and Owner from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.07 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.08 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.09 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression

gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08 GLASS SCHEDULE

A. Glass Type GL-1: Low-E-coated, tinted insulating glass.

1. Basis-of-Design Product: Vitro *SOLARGRAY* - Solarban 60. Product selected to match existing glass. Evaluate samples at site with Owner’s representative for final selection.

2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Color to be selected by A/E.
6. Interspace Content: Argon.
7. Indoor Lite: fully tempered float glass.
8. Low-E Coating: Pyrolytic on second.
9. Winter Nighttime U-Factor: .29 maximum.
10. Summer Daytime U-Factor: .27 maximum.
11. Visible Light Transmittance: 70 percent minimum.
12. Solar Heat Gain Coefficient: 0.39 maximum.
13. Safety glazing required.

END OF SECTION 08 80 00

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior and exterior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.02 SUBMITTALS

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

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.01NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating, unless otherwise indicated.

2.02 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch (25.4 by 4.76 mm).

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: As indicated on Drawings.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 1 1/2 inch (38.1 mm) deep.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock. Provide exterior rated system when applicable.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640-C Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.03 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0312 inch (20 GA.).

B. Slip-Type Head Joints: At all Structural Steel connections and where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Steel Network Inc. (The); VertiClip SLD Series.
        2) Superior Metal Trim; Superior Flex Track System (SFT).

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm.

D. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
2. Depth1-1/2 inches (38.1 mm).

F. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.04AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.02 INSTALLING SUSPENSION SYSTEMS

A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

B. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Do not attach hangers to steel roof deck.
4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.03 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb, unless otherwise indicated. Retain subparagraph below if one-piece control joints are required at heads of doors.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.

C. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

D. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section 07210 – Building Insulation) vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 09 22 16

SECTION 09 29 00
GYPSUM BOARD

PART1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. Tile backing panels.
3. Exterior and cavity wall glass-mat gypsum sheathing board

1.02 SUBMITTALS

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

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.03 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.01 RECYCLED CONTENT OF GYPSUM PANELS

A. Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of percent by weight.

2.02 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board:

1. Complying with ASTM C 1178/C 1178M.

a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.

2. Complying with ASTM C1177/C 1177M.

a. Product: Subject to compliance with requirements, provide "DensArmor Plus Interior Guard" by G-P Gypsum.

2.03 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.04 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.01 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.02 APPLYING TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

C. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.03 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.04 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 13
CERAMIC TILING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Porcelain tile.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Each type and composition of tile and for each color and finish required.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America, or who can demonstrate compliance with its certification program requirements.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of floor tile installation.
2. Build mockup of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 TILE PRODUCTS

A. Porcelain Floor Tile

1. Marazzi, Basalto, 12”x24”, matte finish.

B. Porcelain Wall Tile

1. Marazzi, Basalto, 12”x24”, matte finish.

C. Colors to be chosen from manufacturer’s standard colors.

D. Hard surface floors must pass or exceed ANSI B101.1 and ANSI B101.3.

E. Flooring – Tile pattern in any combination of sizes no larger than a 12” x 24” tile, with a STATIC coefficient of friction (SCOF) .6 wet or greater. If testing results are not provided by manufacturer’s independent testing will be done. Contact State Farm Interior Design for testing facilities.

2.02 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Bostik, Inc.

2. For wall applications, provide non-sagging mortar.

2.03 GROUT MATERIALS

A. Epoxy Grout

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mapei, See Schedule on drawing sheets and/or Material Legend

2.04 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material. Color to be chosen from manufacturer’s standard colors.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Schluter Systems LP.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

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

3.02 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's finishes edge or finishes metal edge strips where necessary to eliminate cut exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in pattern, as indicated on drawing sheets, unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

    1. Porcelain Tile: 1/8 inch.

H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

I. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

END OF SECTION 09 30 13

SECTION 09 51 10
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.02 SUBMITTALS

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

B. Samples: For each exposed finish.

C. Product test reports.

1.03 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.

a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Comply with the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

1.04 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.01 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Acoustical Panel Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch (2.69-mm) diameter wire.

E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.02 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Product: Subject to compliance with requirements, provide Armstrong Ultima Tegular.

C. Color: White.

D. Thickness: 3/4-inch.

E. Modular Size: 24 by 24 inches.

2.03 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide:

1. Armstrong 15/16-inch Prelude.

C. Double-Web, Fire Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 9/16-inch (24-mm) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Cap Material: Steel or aluminum cold-rolled sheet.
4. Cap Finish: Painted white.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.

C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
2. Do not attach hangers to steel deck tabs.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to

substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF DOCUMENT 09 51 10

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.02 SUBMITTALS

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

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples of each resilient product color, texture, and pattern required.

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.04 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Johnsonite.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous.
3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Finish: To be selected from manufacturer’s standard.

I. Colors and Patterns: 63 Burnt Umber.

2.02 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Johnsonite.

B. Description: Reducer strip for resilient floor covering.

C. Material: Rubber.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.03 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Cove Base Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.02 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

3.03 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient floor covering that would otherwise be exposed.

3.04 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

C. Cover resilient products until Substantial Completion.

End of Section 09 65 13

SECTION 09 65 19
RESILIENT TILE FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Solid vinyl (Luxury Vinyl Tile -LVT) floor tile.

1.02 SUBMITTALS

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

B. Samples: 6" X 12", three of each color proposed to match basis of design or Manufacturer's standard colors for sheet products.

C. Maintenance data.

1.03 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.04 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.01 VINYL COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements, provide the following:

1. Armstrong World Industries, Inc.

B. Tile Standard: ASTM F 1700, Class 3, type B embossed surface.

C. Thickness: 0.125 inch (3.2 mm).

D. Size: 6 by 36 inches.

E. Colors and Pattern: Basis-of-Design Products: Subject to compliance with requirements, provide the following products.

1. Armstrong Spettro, color TBD.

2.02 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. LVT Adhesives: Not more than 50 g/L.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.02 FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile and sheet flooring.

B. Lay out floor tiles from center marks as shown on floor pattern drawings established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis, as shown on floor pattern drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.03 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of flooring.

B. Cover flooring until Substantial Completion.

END OF SECTION 096519

SECTION 09 91 00
PAINTING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, the Construction Contract, including all Exhibits and Division 01 Specification Sections, apply to this Section.

B. Section 02 41 19 – Selective Demolition for existing lead-based paint requirements.

1.02 SUMMARY

A. Section Includes:

1. Interior Painting:

a. Cementitious Materials:

1.) Concrete.
2.) Concrete masonry units.

b. Metal Materials:

1.) Ferrous metals.
2.) Zinc-coated metals.

c. Gypsum board.
d. Fiberglass faced gypsum.
e. Plywood and trim.

2. Maintenance Repainting:

a. Removing existing paint.
b. Patching substrates.
c. Painting previously painted surfaces.

1.03 DEFINITIONS

A. Painting: Surface preparation, priming, and finish coats for painted surfaces.

1. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

2. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

1.03 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.04 SYSTEM DESCRIPTION

A. Paint exposed surfaces in new construction and in existing construction affected by new work whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural.

1. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.
2. If color or finish is not designated, the Owner's representative will select from standard colors or finishes available.
3. Painting includes field painting exposed bare and covered pipes and paint grade ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

B. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, labels and existing roof structural elements, unless called for on drawings.

1. Pre-finished items not to be painted include the following factory-finished components:

a. Toilet enclosures.
b. Acoustic materials.
c. Architectural woodwork and casework.
d. Finished mechanical and electrical equipment.
e. Light fixtures.
f. Switchgear.
g. Distribution cabinets.

2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:

a. Foundation spaces.
b. Furred areas.
c. Utility tunnels.
d. Pipe spaces.

e. Duct shafts.
f. Elevator shafts.

3. Finished metal surfaces not to be painted include:

a. Anodized aluminum.
b. Copper and copper alloys.
c. Stainless steel.
d. Chromium plate.

4. Operating parts not to be painted include moving parts of operating equipment such as the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

6. Existing roof structural elements:

a. Existing exposed roof beams, joists, decking and miscellaneous roof framing, unless noted otherwise on the drawings.

C. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect and Owner of problems anticipated using the materials specified.

1.05 SUBMITTALS

A. Product Data:

1. Submit for action. Describe the properties of items to be used in the Work. Include the following.

a. Manufacturer's technical information, label analysis, and application instructions.

1) List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

B. Shop Drawings: Submit for action. Show fabrication and installation of the Work. Include the following.

1. Floor Plans and Elevations: Indicate colors and paint systems location on floor plans. Provide elevation of colors and paint systems where surface to be painted has more than one color and / or system.

C. Samples:

1. Initial Selection: Submit for action. Furnish manufacturer's complete color selection showing full range of colors and finish characteristics.

2. Verification: Submit for action. Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.

a. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
b. Provide a list of material and application for each coat.
c. Submit 3 drawdowns of each product and color combination. Drawdowns shall be applied using a 4 mil WFT (wet film thickness) drawdown bar on Leneta form WD plain white coated cards size 4 inch x 6 inch (98.4 mm x 152.4 mm). Label each card with the job name, product name and number, color number as stated in the color schedule, and the name and address of the supplying facility.

1.06 EXTRA MATERIAL

A. Furnish extra materials in unopened containers, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 3 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.07 QUALITY ASSURANCE

A. Qualifications:

1. Contractor: Contractor is responsible for quality control of the Work.
2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

B. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

C. Single Source Responsibility: Obtain materials from a single manufacturer for the complete system.

D. Mockups: Use the same installation methods and materials as required for the Work. Schedule construction so that it may be reviewed, and any necessary adjustments made, prior to commencing fabrication of the Work. When accepted, mock-up shall serve as the standard for materials, workmanship, and appearance throughout the Project.

1. Provide the following mock-ups at location to be designated.

a. Walls and Ceilings: Architect and Owner to select location and size of mock-up.
b. Doors, Frames: Architect and Owner to select location and size of mock-up.

2. Accepted mock-ups in undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver materials in manufacturer’s original packaging with label indicating pertinent information identifying the item. Store materials in accordance with manufacturer’s instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation. Label to include the following.

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Storage and Protection:

1. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue. Keep storage area neat and orderly.
2. Protect from freezing.
3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.09 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements: Proceed with the Work in accordance with manufacturer's requirements and instructions, including the following.

1. Water Based Paint: Apply only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).
2. Solvent Thinned Paint: Apply only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
3. Snow, Rain, Fog, or Mist: Do not apply paint when the relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.
4. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

1.10 SEQUENCING AND SCHEDULING

A. Perform maintenance repainting in the following sequence, which includes work specified in this and other Sections:

1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag items with location identification and protect.
2. Verify that temporary protections have been installed.
3. Examine condition of surfaces to be painted.
4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
5. Apply paint system.
6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

PART 2 – PRODUCTS

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide one of the following. Paint manufacture's products used as basis for design of systems in 3.13 Paint Schedule. Quality of products shall not be less than those required by MPI Standards and as referenced by MPI numbering system in Paint Schedule.

1. Benjamin Moore and Co. (Moore).
2. PPG Industries, Pittsburgh Paints (Pittsburgh).
3. The Sherwin-Williams Company (S-W).
4. Or Equal.

2.03 PAINT MATERIALS

A. Material Quality: Paint material containers not displaying manufacturer's product identification will not be acceptable.

B. Paint Systems

1. Provide paints that meet the Green Seal Standard GS-11 requirements.
2. Refer to Schedule at end of section for paint systems.

C. Paint Colors:

1. Manufacturer / Color: Match Architect’s samples. See Interior Finish Schedule on Drawings.

D. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.04 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.05 PAINT REMOVERS

A. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinseable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

2.06 PATCHING MATERIALS

A. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of

metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

C. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C 842 and manufacturer's written instructions.

PART 3 – EXECUTION

3.02 EXAMINATION

A. Site Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation. Comply with the following requirements.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.03 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize and collect alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.04 MAINTENANCE REPAINTING, GENERAL

A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from painted surface and from building exterior at 20 feet (6 m) away from painted surface.

B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for repainting.
3. Allow other trades to repair items in place before repainting.

C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.

D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.05 PREPARATION

A. General:

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

B. Surface Preparation and Preparatory Cleaning:

1. General:

a. Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
b. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1) Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

c. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
d. Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
e. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect and Owner in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.

2. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to

remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

3. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

4. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

5. Chemical Rust Removal:

    a. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
    b. Apply rust remover with brushes or as recommended in writing by manufacturer.
    c. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
    d. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
    e. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
    f. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

6. Mechanical Rust Removal:

    a. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
    b. Wipe off residue with mineral spirits and either steel wool or soft rags.
    c. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
    d. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

7. Cementitious Materials:

    a. General: Prepare surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

1) Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
2) Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

8. Metal Materials:

   a. Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, solvent cleaning.
   b. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

      1) Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC-SP 10.
      2) Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      3) Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

   c. Galvanized Metals: Clean galvanized surfaces with non- petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

9. Gypsum Board Substrates:

   a. Do not begin paint application until finishing compound is dry and sanded smooth.

10. Wood Materials:

    a. Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
    b. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

C. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.06 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

    a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
    b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.

2. Brushes: Use brushes that are resistant to chemicals being used.

    a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
    b. Wood Substrates: Do not use wire brushes.

3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
    c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
    d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

C. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with water applied by low or medium-pressure spray to remove chemicals and paint residue; water temperature and pressure level as recommended by manufacturer.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

3.07 APPLICATION

A. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

1. Pigmented Finishes: If undercoats or other conditions show through pigmented topcoat/overcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
2. Clear Finishes: Produce a smooth surface film of even sheen using multiple coats.

C. Apply a transition coat over incompatible existing coatings.

3.08 INSTALLATION

A. General: Install system in accordance with manufacturer’s printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
3. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or recoat work not in compliance with specified requirements.

B. Painting:

1. Paint colors, surface treatments, and finishes are indicated in "schedules".
2. Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

    a. Tint each coat of paint slightly different from the previous coat, but identifiable from each other.

3. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, ductwork and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
5. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
6. Paint interior surfaces of ducts and other items, where visible through registers or grilles, with a flat, nonspecular black paint.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

C. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.

1. Mechanical items to be painted include but are not limited to:

    a. Piping, pipe hangers, and supports.
    b. Heat exchangers.
    c. Tanks.
    d. Paint Grade Ductwork.
    e. Insulation.
    f. Supports.
    g. Motors and mechanical equipment.
    h. Accessory items.

2. Electrical items to be painted include but are not limited to:

    a. Conduit and fittings.

3. Mechanical and Electrical equipment supplied with factory finish shall not be painted.

3.09 CLEANING

A. Remove empty cans, rags, rubbish, and other discarded paint materials from the site at the end of each day.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.10 PROTECTION

A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

1. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect and Owner.

3.11 INTERIOR PAINT SCHEDULE

A. Cementitious Materials:

1. Concrete.

a. Walls: Acrylic, Semi-Gloss Finish (MPI - INT 3.1A):

1) Primer:

a) Moore: Pristine Eco Spec Interior Latex Primer (231)
b) Pittsburgh: Perma-Crete Int/Ext Latex Alkali Resistant Primer 4-603
c) S-W: Loxon Concrete & Masonry Primer Sealer (A24W08300)
d) Or Equal

2) First and Second Coats:

a) Moore: Pristine Eco Spec Interior Latex Semi-Gloss Enamel (224)
b) Pittsburgh: Pure Performance Interior Eggshell Latex (9-300 Series)
c) S-W: ProMar 200 Zero VOC Interior Latex (B31-2600)
d) Or Equal

b. Walls: Latex, Eggshell Finish:

1) Primer:

a) Moore: Pristine Eco Spec Interior Latex Primer (231)
b) Pittsburgh: Perma-Crete Int/Ext Latex Alkali Resistant Primer 4-603
c) S-W: Loxon Concrete & Masonry Primer Sealer (A24W08300)
d) Or Equal

2) First and Second Coats:

a) Moore: Eco Spec Interior Eggshell Enamel (223)
b) Pittsburgh: Pure Performance Interior Eggshell Latex (9-300 Series)
c) S-W: ProMar 200 Zero VOC Interior Latex (B20-2600)
d) Or Equal

2. Concrete Masonry Units (MPI – INT 4.2A).

    a. Walls: Acrylic, Semi-Gloss Finish:

        1) Primer:

            a) Moore: Pristine Eco Spec Interior Latex Primer (231)
            b) Pittsburgh: Speedhide Interior/Exterior Masonry Block Filler Latex (6-12)
            c) S-W: PrepRite Block Filler (B25W25)
            d) Or Equal

        2) First and Second Coats:

            a) Moore: Pristine Eco Spec Interior Latex Semi-Gloss Enamel (224)
            b) Pittsburgh: Pure Performance Interior Eggshell Latex (9-300 Series)
            c) S-W: ProMar 200 Zero VOC Interior Latex (B31-2600)
            d) Or Equal

B. Metal Materials:

1. Ferrous Metals, unless otherwise specified:

    a. Latex, Semi-Gloss Finish (MPI – INT 5.1A):

        1) Primer:

            a) Moore: IronClad Latex Low Lustre Metal and Wod “Enamel (363)
            b) Pittsburgh: Pit-Tech Int/Ext Primer/Finish DTM Industrial Enamel (90-712 Series)
            c) S-W: Pro-Cryl Universal Water Based Primer (B66-310)
            d) Or Equal

        2) First and Second Coats:

            a) Moore: Pristine Eco Spec Interior Latex Semi-Gloss Enamel (224)
            b) Pittsburgh: Pure Performance Interior Semi-Gloss Latex (9-510 Series)
            c) S-W: Promat 200 Zero VOC (B31-2600)
            d) Or Equal

2. Zinc-Coated Metals (MPI – INT 5.3A):

    a. Latex, Semi-Gloss Finish:

        1) Primer:

            a) Moore: IronClad Latex Low Lustre Metal and Wood Enamel (363)
            b) Pittsburgh: Pit-Tech Int/Ext Primer/Finish DTM Industrial Enamel (90-712 Series)
            c) S-W: Pro-Cryl Universal Water Based Primer (B66-310)

d) Or Equal

2) First and Second Coats:

a) Moore: Pristine Eco Spec Interior Latex Semi-Gloss Enamel (224)
b) Pittsburgh: Pure Performance Interior Semi-Gloss Latex (9-510 Series)
c) S-W: Harmony Interior Latex Semi-Gloss (B10 Series)
d) Or Equal

3. Steel Columns:

a. Epoxy/Urethane Systems (solvent-based), Gloss Finish (MPI – INT 5.1Z):

1) First Coat:

a) S-W: Macropoxy 646 Fast Cure Epoxy (B58W610 series)

1) 5-10 mils DFT

b) Or Equal.

2) Second Coat:

a) S-W: Macropoxy 646 Fast Cure Epoxy (B58W610 series)

1) 5-10 mils DFT

b) Or Equal.

4. Metal Doors/Frames and Hollow Metal Window Frames:

a. Epoxy (water-based), Semi-Gloss Finish (MPI – INT 5.1N):

1) Primer:

a) S-W: Pro Industrial Pro-Cryl Universal Primer (B66-310 series)
b) Or Equal.

2) First Coat:

a) S-W: Pro-Industrial Pre-Catalyzed Water-based Epoxy (K46 series)
b) Or Equal:

3) Second Coat:

a) S-W: Pro-Industrial Pre-Catalyzed Water-based Epoxy (K46 series)
b) Or Equal.

C. Paper Faced Gypsum Board:

1. Walls:

a. Latex, Eggshell Finish (MPI – INT 9.2A).

1) Primer:

a) Moore: Pristine Eco Spec Interior Latex Primer (231)
b) Pittsburgh: Pure Performance Interior Latex Primer (9-900)
c) S-W: ProMar 200 Zero VOC Interior Latex Primer (B28W2600)
d) Or Equal

2) First and Second Coats:

a) Moore: Eco Spec Interior Eggshell Enamel (223)
b) Pittsburgh: Pure Performance Interior Eggshell Latex (9-300 Series)
c) S-W: ProMar 200 Zero VOC Latex Egg-Shell (B20-2600 series)
d) Or Equal

b. Latex, Semi-Gloss Finish (MPI – INT 9.2A).

1) Primer:

a) Moore: Pristine Eco Spec Interior Latex Primer (231)
b) Pittsburgh: Pure Performance Interior Latex Primer (9-900)
c) S-W: ProMar 200 Zero VOC Interior Latex (B28W2600)
d) Or Equal

2) First and Second Coats:

a) Moore: Eco Spec Interior Semi-Gloss Enamel (224)
b) Pittsburgh: Pure Performance Interior Semi-Gloss Latex (9-500 Series)
c) S-W: ProMar 200 Zero VOC Interior Latex (B31-2600)
d) Or Equal

D. Wood

1. Painted standing and running trim:

1) Latex System (MPI – INT 6.3A):

a) Prime Coat: Primer, latex, for interior wood
b) Intermediate Coat: Latex, interior, matching topcoat.
c) Topcoat: Latex, interior, semi-gloss, (Gloss Level 5)

END OF SECTION 09 91 00

SECTION 10 21 13.13
METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes painted steel toilet compartments configured as toilet enclosures and urinal screens.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, and attachment details.

C. Samples for each type of toilet compartment material indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.02 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.01 PAINTED STEEL TOILET COMPARTMENTS

A. Accurate Partitions Corporation

B. Toilet-Enclosure Style: Floor mounted w/ headrail bracing.

C. Urinal-Screen Style: Wall hung, flat panel.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf (1112 N), when tested according to ASTM F 446, without deformation of panel.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.

F. Facing Sheets and Closures: Electrolytically coated steel or hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.048 inch.
2. Panels: Manufacturer's standard thickness, but not less than 0.030 inch.
3. Doors: Manufacturer's standard thickness, but not less than 0.030 inch.
4. Flat-Panel Urinal Screens: Thickness matching the panels.

G. Pilaster Shoes: Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

H. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; aluminum.

I. Steel Sheet Finish: Manufacturer's standard baked-on finish.

1. Color: To be selected from manufacturer’s standard colors.

2.02 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.03 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.

B. Floor-Mounted Units: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to headrail bracing.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Design and coordinate additional above ceiling framing as required to support ceiling-hung units.

3.02 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 51 13
METAL LOCKERS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes lockers.

1. Wardrobe Locker Configuration: Single tier.
2. Locker Benches

1.02 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Show locker sloping tops, and accessories. Include locker-numbering sequence.

C. Samples: For each exposed finish and for each color and texture required.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver master keys, control keys, and combination control charts to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: PDQ / Republic Storage Products, LLC

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 366/A 366M, matte finish, suitable for exposed applications, and of stretcher-leveled flatness.

1. Corrosion Resistance: Fabricate from galvannealed steel sheet.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.03 WARDROBE LOCKERS

A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners.

1. Back-Material Sheet Thickness: 0.0478 inch.
2. Side-Material Sheet Thickness: 0.0598 inch.
3. Exposed Ends: Form exposed ends of non-recessed lockers from minimum 0.0598-inch- thick steel sheet.
4. Size: 12 inch wide x 18 inch deep x 78 inch high.

B. Frames: Form channel frames from minimum 0.0598-inch- thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.

1. Latch Hooks: Form from minimum 0.1046-inch- thick steel; welded or riveted to door frames.

C. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 deg rees.

1. Sheet Thickness: 0.0747 inch minimum.
2. Reinforcement: Brace or reinforce inner face of doors more than 15 inches wide.
3. Vents: Stamped louvered in door face.

D. Shelves: Provide hat shelf in single-tier units; fabricated from minimum 0.0239-inch-thick, formed steel sheet; flanged on all edges.

E. Hinges: Steel, full loop, 5 or 7 knuckle; tight pin; minimum 2 inches high. Weld to inside of door frame and attach to door with at least two factory-installed fasteners that are completely concealed and tamper resistant when door is closed.

1. Provide at least 3 hinges for each door more than 42 inches high and at least 2 hinges for each door 42 inches high or less.

F. Projecting Handle and Latch: Manufacturer's standard, positive automatic, pre-locking, pry-resistant latch and pull; chromium-plated, heavy-duty, vandal-resistant, lift-up handle.

1. Provide minimum 3-point latching for each door more than 42 inches high; minimum 2-point latching for each door 42 inches high or less.
2. Provide single-point gravity or spring-actuated latch with padlock lug.

G. Locks: Combination padlock.

H. Accessories:

1. Base: Legs with closed base, 6 inches high.
2. Sloping Tops: Continuous.
3. Recess Trim: Required.
4. End Panels: Finished.

I. Locker Fabrication: All welded.

2.04 LOCKS

A. Fabricate lockers to receive the following locking devices, installed on lockers using security-type fasteners:

1. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes.

2.05 LOCKER ACCESSORIES

A. Interior Equipment: For each locker.

1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks for single-, double-, and triple-tier units. Attach hooks with at least two fasteners.
2. Coat Rods: Manufacturer's standard galvanized steel. Provide rod in lieu of ceiling hook for lockers 18 inches deep or greater.

B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch high. Number lockers in sequence determined by Owner. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

C. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359-inch- thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and vertical-end type closures.

D. Recess Trim: Manufacturer's standard; fabricated from minimum 0.0478-inch- thick steel sheet, minimum 2-1/2-inch face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.

E. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- thick steel sheet in an unequal leg angle shape and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

F. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch-thick steel sheet, finished to match lockers, and designed for concealing exposed ends of non-recessed lockers.

2.06 LOCKER BENCHES

A. By Locker Manufacturer

B. Provide bench units with overall assembly height of 17 ½ inches x 4'-0" length.

C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9 ½ inches wide by 1 ¼ inches thick.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.

E. Materials:

1. Stainless Steel: ASTM A 666, Type 304.
2. Steel Tube: ASTM A 500/A 500 M, cold rolled.

2.07 FABRICATION

A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.

B. All-Welded Construction: Preassemble lockers by welding all joints, seams, and connections, with no bolts, screws, or rivets used in assembly. Grind exposed welds flush.

C. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.

1. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.

D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches.

2.08 FINISHES

A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.

B. Steel Sheet Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

C. Steel Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils on doors, frames, and legs, and 1.1 mils elsewhere.

1. Color and Gloss: As selected from manufacturer's full range.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All-Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

B. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

C. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

D. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of non-recessed lockers.

E. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 10 51 13

SECTION 10 80 10
TOILET AND SHOWER ACCESSORIES

PART1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Toilet and shower accessories.
2. Under-lavatory guards

B. Related Work Specified Elsewhere:

1. Accessories in prefabricated shower units: Integral with shower assemblies; specified in Division 22 - Plumbing.

1.02 SUBMITTALS

A. Product Data: For each product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use room designations indicated on Drawings.

1.03 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace mirrors that develop visible silver spoilage defects within 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01MANUFACTURERS

A. As listed in TOILET AND BATH ACCESSORIES SCHEDULE.

2.02MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.03TOILET AND BATH ACCESSORIES SCHEDULE

A. Men – 102 & Women - 103

1. Toilet Tissue Dispenser:

   a. Product: Bobrick Model B-3474.

2. Grab Bars: As shown on drawings.

   a. Product: Bobrick Model B-6806.
   b. Length: 18” (1 each), 42” (1 each) and 36” (1 each).

3. Paper Towel Dispenser:

   a. Product: Bobrick B-2620

4. Mirror Unit:

   a. Product: Bobrick Model B-165 1836.

5. Under-lavatory Guard:

   a. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

   b. Manufacturers
      1. Brocar Products, Inc.
      2. Truebro, Inc.

7. Wall Mounted Soap Dispenser

   a. Product: Bobrick B-2111

8. Sanitary Napkin Disposal (Women – 103 only)

a. Product: Bobrick B-270

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10 80 10

SECTION 13 34 19
METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal roof panels.
2. Metal wall panels.
3. Thermal insulation.
4. Accessories.

B. Related Sections:

1. Section 08 11 13 Hollow Metal Doors and Frames.
2. Section 08 36 13 Sectional Doors.
3. Section 08 51 13 Aluminum Windows.

1.02 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

B. Shop Drawings: Indicate components by others. Include full details and attachments to other work.

C. Samples: For units with factory-applied finishes.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 40 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.

B. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

C. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

D. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

E. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

G. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C 1363 or ASTM C 518:

1. Roof:

   a. U-Factor: 0.035.
   b. R-Value: R-19 + R-11 LS.

2. Walls:
   a. U-Factor: 0.052.

   b. R-Valute: R-13 + R-13 c.i.

2.02 METAL ROOF PANELS

A. Basis of Design: Butler MR-24. Standing-Seam, Trapezoidal-Rib, Metal Roof Panels: Formed with interlocking ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (0.61-mm) nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

   a. Exterior Finish: Two-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

2. Clips: Two-piece floating to accommodate thermal movement.
3. Joint Type: Mechanically seamed.
4. Panel Coverage: 24 inches (610 mm).
5. Panel Height: 3 inches (76 mm).

2.03 METAL WALL PANELS

A. Basis of Design: Butler Stylwall II Fluted. Concealed Fastener, Metal Wall Panels: Formed with raised, trapezoidal major ribs and flat pan between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using concealed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (0.61-mm) nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Exterior Finish: Two-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 6 inches (152 mm) o.c.
3. Panel Coverage: 16”.
4. Panel Height: 3”.

B. Basis of Design: MBCI FW-120, concealed fastener, metal wall panels: Formed as flat panel with (2) pencil ribs per face; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using concealed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (0.61-mm) nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Exterior Finish: Two-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

2. Pencil-Rib Spacing: 4 inches
3. Panel Coverage: 12”.
4. Panel Height: 1 ½ ”.

C. Basis of Design: Interior, exposed fastener, metal wall panels: Metal building manufacturer’s standard liner panel with exposed fasteners.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Exterior Finish: Siliconized polyester.
b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 6 inches (152 mm) o.c.
3. Panel Coverage: 36 inches (914 mm).
4. Panel Height: 0.75 inch (19mm).

2.04 THERMAL INSULATION

A. Roof Insulation: Minimum R-19 + R-11 LS as required by the 2018 International Energy Conservation Code.

B. Wall Insulation: Maximum U-0.052 as required by the 2018 International Energy Conservation Code.

C. Basis of Design for Roof and Wall Insulation: Simple Saver System by Thermal Design. Provide Simple Saver System that includes all insulation, strapping, fabric/vapor barrier, anchors, etc. for complete installation and manufacturer's 10 year warranty.

2.05 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) nominal uncoated steel thickness, pre-painted with coil coating; finished to match adjacent metal panels.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) nominal uncoated steel thickness, pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2438-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) nominal uncoated steel thickness, pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Roof Curbs: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch (1.21-mm) nominal uncoated steel thickness pre-painted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

I. Snow Guards

1. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.

a. Seam-Mounted, Bar-Type Snow Guards: Aluminum or stainless-steel rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

1) Aluminum Finish: Clear anodized.
2) Stainless-Steel Finish: No. 2B.
3) Products: Subject to compliance with requirements, provide one of the following:

a) Alpine SnowGuards, Div. of Vermont Slate & Copper Services, Inc.;
b) LMCurbs;
c) Metal Roof Innovations, Ltd.;
d) Riddell & Company, Inc.;
e) Snow Management Systems, a division of Contek, Inc.;
f) TRA-MAGE, Inc.

2.06 FABRICATION

A. Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 - EXECUTION

3.01 METAL PANEL INSTALLATION, GENERAL

A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

B. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.02 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
6. Provide metal closures at peaks, rake edges, rake walls and each side of ridge caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.03 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches (102 mm) minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.04 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in R or U value indicated to cover entire surface, according to manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

3.05 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls;

locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

END OF SECTION 13 34 19

DIVISION 22 – PLUMBING
Section 22 05 00 – Basic Plumbing Materials
And Methods

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. All applicable requirements of other portions of the Contract Documents apply to the Work of this Section including, but not limited to, all Drawings, all Specifications, General Conditions, and General Requirements including submittals.

1.02 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations to expand the requirements specified in Related Documents.

1.03 RELATED WORK

A. Specified Elsewhere:

1. Section 22 05 29 – Sleeves, Supports, Hangers, Anchors and Seals
2. Section 22 07 19 – Piping Insulation
3. Section 22 10 00 – Plumbing
4. Section 22 10 19 – Plumbing Specialties
5. Section 22 11 23 – Gas Piping
6. Section 22 40 00 – Plumbing Fixtures

1.03 REFERENCE TO STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

B. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Project Representative for a decision before proceeding.

C. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.

1.04 SUBMITTALS

A. General: Submit in accordance with Division 1.

B. Prior to the performance of any work or installation of any materials, obtain approval from the Project Representative by submitting shop drawings and data sheets.

C. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from Subcontractors and material suppliers directly to the Project Representative will not be accepted or processed.

D. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Drawings and data sheets shall show:

1. Principal dimensions and details of construction.
2. Weights of principal parts and total weights with information required for the design of supports and foundations.
3. Sizes and locations of piping and connections.
4. Performance data, including pump and fan curves; fan discharge and inlet noise data; certified by the manufacturer for the equipment furnished.
5. Data on electric motors, including break HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
6. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.
7. Automatic temperature control system including diagrammatic layout of piping, wiring, control device, and equipment, and detailed descriptions of each item of equipment and its function in the system and system operation.
8. Refrigeration for field-assembled systems including description of specialties and pressure drops, layout of piping with lengths, fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.

E. Approval of shop drawings does not release Contractor from responsibility of coordinating his work at job site and taking field measurements. In cases where interferences become apparent, the Contractor shall notify the Project Representative so that such interferences may be resolved prior to proceeding with shop work. No claim will be allowed for work that might have to be moved or replaced based on a claim that work was placed in accordance with dimensions shown on an approved shop drawing.

1.05 RECORD DOCUMENTS

A. Record documents shall be developed in accordance with Division 1.

B. Record Documents: Maintain a clean, undamaged set of Contract Documents and

Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Documents. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the Project Representative, but was not shown on Contract Drawings or Shop Drawings.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
6. Contract Modifications, actual equipment and materials installed.

C. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.

1.06 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

A. Operating and Maintenance Manuals shall be developed in accordance with Division 1.

B. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Spare parts list.
2. Copies of warranties.
3. Wiring diagrams.
4. Inspection procedures.
5. Shop Drawings and Product Data.
6. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
7. Manufacturer's printed operating procedures to include start-up, break-in, and

routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
9. Servicing instructions and lubrication charts and schedules.

C. All controls and safety devices shall be clearly and permanently marked with embossed or printed plates as to purpose and as to operation and shall be tested in the presence of the Owner's designated representative to insure that he understands their function and purpose.

D. Upon completion of the work, the Contractor shall put the systems into service. The Contractor shall be entirely responsible for the equipment during all testing operations including the turning on and off the apparatus. Each Contractor shall provide the Owner, three 4-hour instruction sessions in the operation of the equipment and systems.

1.07 WARRANTIES

A. Refer to Related Documents for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Division 22, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.08 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project.

B. When two or more items of same material or equipment are required, they shall be by the same manufacturer. Product manufacturer uniformity does not apply as applicable for project to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

C. Provide products which are compatible within systems and other connected items.

1.09 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location.

1.10 DEFINITIONS

A. The following terms are used throughout the contract documents. The work will be governed in accord with the definitions.

1. The term "Piping" refers to pipe, fittings, valves, flanges, unions, specialties and accessories and appurtenances necessary for, or incidental to, a complete system.
2. The term "concealed work" refers to piping and ductwork above ceilings and within walls, partitions, shafts or service spaces, not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would be by removal of finish materials.
3. The term "concealed but accessible work" refers to piping and ductwork accessible above or through suspended ceilings, in walls at access panels or in chases with access doors or mandoors.
4. The term "exposed work" refers to piping or equipment normally exposed to view within rooms or open areas.

PART 2 PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Materials, products, and equipment shall be delivered to job site with factory packaging bearing manufacturer's name or label, and union label whenever practical.

B. Provide for each piece of equipment any special tools required for the operation or adjustment of the equipment and turn over to the Project Representative prior to final approval of the equipment.

C. Exposed machined surfaces of equipment such as shafts, bearing surfaces, gasket surfaces, gears, etc., shall be provided with adequate protection at the factory to prevent physical damage and corrosion prior to installation.

D. Equipment openings and connections shall be provided with adequate covers at the factory to protect the internals, threads, and flanges and prevent entrance of any foreign matter prior to installation.

2.02 MOTORS AND DRIVES

A. Acceptable Manufacturers:

1. General Electric
2. Lincoln
3. Reliance
4. Gould
5. Siemens
6. Louis-Allis
7. Baldor
8. Peerless
9. Century

B. Motors shall be standard NEMA design, of size and characteristics as indicated on the Drawings. Motors shall comply with the specifications set forth in Division 26.

C. Motors shall have the following features:

1. Arranged to operate continuously under full load in an ambient temperature of 40 degrees Centigrade.
2. Motor service factor not less than 1.15, determined by the specific application.
3. Drip-proof unless specific application requires a hermetic, totally enclosed or explosion proof motor as noted.
4. Provided with either internal or external thermal overload protection. Motors to be used with variable frequency controllers shall have internal thermal overload protection.
5. Permanently lubricated or grease reservoir type bearings. Reservoir type bearings shall have top and bottom screw plugs for flushing and repacking.
6. For convenient access (particularly to clear belt guards) the lubrication fittings shall be extended with pipe and fittings properly secured in place.
7. Windings shall be copper.

D. Drives shall have the following features:

1. Belted motors shall have sliding bases for adjustment of belt tension.
2. Sheaves shall be of the vari-pitch type, except for equipment used with variable speed controllers. Drives and driven sheaves shall be machined cast steel.
3. Belt drives shall be of V-belt type with drive capacity of at least 150 percent of motor horsepower. Belts shall be matched sets when multiple belt drives are used. No fan of integral HP or greater shall have less than two belts.
4. Belt drives, shafts and couplings shall be fully guarded with heavily reinforced expanded metal or woven wire in accordance with OSHA and National Safety Council Standards.

5. Provide openings in the guards all shafts to permit the use of a tachometer.

E. The following Table indicates minimum efficiencies and power factors for three phase motors operating fully loaded at 1800 rpm with electrical characteristics of 200, 230, 460 volts, 60 hertz.

Horsepower		Efficiency	Power Factor
1		82.5	84
1-1/2	84.0	85.7	
2		84.0	85.7
3		85.5	85.0
5		86.5	88.0
7-1/2		88.5	81.0
10		89.5	85.5
15		90.0	84.5
20		91.0	86.0

PART 3 EXECUTION

3.01 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with

individual system requirements, refer conflict to the Project Representative.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
14. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

3.02 ELECTRICAL WIRING

A. Contractor furnishing mechanical equipment shall provide all low voltage and line voltage control circuit wiring, conduit and connections and all wiring associated with starter holding coils, unless specifically designated as another Contractor’s work.

B. Electrical Contractor shall be responsible for all line voltage power wiring and final connections to complete the mechanical systems.

C. All wiring shall be in compliance with all State and Local codes and in accordance with specifications set forth in Division 26.

D. The sharing of space within a common conduit by line voltage conductors and by control circuit conductors shall not be permitted.

3.03 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.04 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Related Documents. In addition, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Project Representative, uncover and restore Work to provide for Project Representative observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.05 PERFORMANCE

A. All equipment and systems shall be protected against freezing, flooding, corrosion, and other forms of damage prior to acceptance by the Project Representative.

B. Design and fabrication features or proven methods not specifically covered by this specification shall be specifically stated and documented in the proposal.

C. Labor shall be furnished for assembling all pieces of equipment which, due to shipping limitations, have components which arrive on the jobsite disassembled.

3.06 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Arrange for each installer of equipment that requires regular maintenance to meet

with the Project Representative's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Spare parts and materials.
2. Tools.
3. Lubricants.
4. Identification systems.
5. Control sequences.
6. Hazards.
7. Cleaning.
8. Warranties and bonds.
9. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. Provide, to the Project Representative, maintenance information identical to that to be submitted for Maintenance Manuals. These manuals are beyond those required for Maintenance Manuals. Certification of Substantial Completion cannot be made without documentation of startup, including the issue of above noted maintenance information.

3.07 FINAL INSPECTION

A. Prior to final acceptance, all systems shall be operated to test performance to the satisfaction of the Project Representative.

1. Water shall circulate throughout systems without noise, water hammer, leaks, trapping, or air-binding.
2. Motors, fans, and other equipment shall operate without excessive noise or vibration.
3. Systems shall be balanced to operate within the stated tolerances. If any device does not operate within the stated tolerances, then the entire system shall be considered out of balance and shall be readjusted until all units are within the stated tolerances.
4. Equipment and machines shall have initial lubrication, and be aligned and tuned-up for efficient performance.
5. Drains shall flow freely, without excessive noise, leaks or stoppages.

B. Defects demonstrated by inspections and tests shall be corrected to the satisfaction of the Project Representative at the Contractor's expense.

3.08 PROTECTION

A. Guards, barricades, lights, services, etc., necessary for the protection of persons and property shall be furnished and maintained.

B. Existing work such as pavements, lawns, sidewalks, floors, curbs, and other structures and utilities which are damaged or disturbed due to making connections or any phase of operations shall be restored to the satisfaction of the Project Representative and the governing authorities.

END OF SECTION 22 05 00

DIVISION 22 – PLUMBING
Section 22 05 29 – Sleeves, Supports, Hangers, Anchors And Seals

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. This section covers the requirements to furnish and install sleeves, supports, hangers, anchors and seals for piping and equipment under this contract.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 22 05 00 – Basic Mechanical Materials and Methods
2. Section 22 10 00 – Plumbing.
3. Section 22 11 23 – Gas Piping.

1.03 REFERENCE TO STANDARDS

A. Standards: Manufacturer's Standardization Society of the Valve and Fittings Industry, M.S.S.:

1. SP 58: Pipe Hangers and Supports - Materials, Design and Manufacture.
2. SP 69: Pipe Hangers and Supports - Selection and Application.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products wrapped in factory-fabricated fiberboard type containers.

B. Do not install damaged products; replace and return damaged units to manufacturer.

C. Store hangers, supports and anchors in clean, dry space. Store in original cartons and protect from dirt, physical damage and construction traffic.

1.06 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Locate all piping, and equipment supports with static and dynamic load on each. Locate all sleeving for mechanical equipment. Locate all flashing for mechanical equipment.

C. Product Data: Provide schedule of sealants with type and location for each.

PART 2 PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

A. Suspension Hangers:

1. Acceptable Manufacturers:

	2-1/2 Inch IPS and Smaller	3 inch IPS and Greater	Copper/Brass Piping, All Sizes
a. Grinnell	Fig. 65	Fig. 260	Fig. CT 65
b. B-Line	Fig. 3104	Fig. 3100	Fig. 3104 CT
c. Persing	Fig. 230	Fig. 200	Fig. 220 CT

2. Adjustable wrought steel clevis type. Copper plated for all hangers in direct contact with copper lines.

B. Adjustable steel yoke pipe roll:

1. Acceptable Manufacturers:

a. Grinnell Fig. 171/181
b. B-Line Fig. B3110/B3114
c. Persing Fig. 322/324

C. Pipe Covering Protection Sleeves for Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 167 Series
b. B-Line Fig. 35L Series
c. Persing Fig. 400 Series

D. Pipe Covering Protection Saddles For Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 160 Series
b. B-Line Fig. 3160 Series
c. Persing Fig. 400 Series

E. Pipe Protection/Thermal Insulation Hanger Shields for Insulated Pipe.

1. Acceptable Manufacturers:

a. B-Line Fig. B3195 Series
b. Insul-shield
c. Pipe Shields
d. Uni-grip

F. Hanger Rods, Galvanized All Thread Rod; ASTM A36:

Hanger rod sizes:

Pipe Size	Hanger Rod Diameter
2 inch and smaller	3/8 inch
2-1/2 inch to 3-1/2 inch	1/2 inch
4 inch to 5 inch	5/8 inch
6 inch	3/4 inch
8 inch	7/8 inch
Over 8 inch	As per Hanger Manufacturer recommendations

G. Wall Brackets:

1. Acceptable Manufacturers:

a. Grinnell Fig. 194/195/196/ Clip Fig. 193
b. B-Line Fig. B3063/B3068/B3067 / Clip Fig. B3063 CP
c. Persing Fig. 153/151/153 / Clip Fig. 153 C

2. Welded steel with capacity as required.

H. Horizontal Pipe Slide Supports:

1. Acceptable Manufacturers:

a. Grinnell 257 Type 3
b. Fluorogold FPS-IT
c. TOBO TPS-100

2. Pipe shall be fixed in place by metal hold down clamps anchored to formed steel channels capped with 1/8 inch Teflon sheet. The Teflon shall be securely fastened to the channel by metal screws or by chemical bond or both.
3. Hold down clamps shall be the "one-piece" type. Hold down clamps shall be sized large enough to allow the pipe to slip in the axial direction thereby allowing for expansion or contraction of the pipe.
4. All metal parts shall be galvanized by the manufacturer and prepared and painted by the plumbing Contractor after assembly. All nuts and bolts shall be cadmium plated.

I. Preformed Metal Framing Channels:

1. Acceptable Manufacturers:

a. Unistrut
b. Superstrut
c. B-Line

2. Continuous slotted steel framing channel in gauge and size for capacities required complete with the matching fittings, nuts, bolts and hangers as shown on the drawings.

J. Auxiliary Steel Angle and/or Pipe:

1. Auxiliary steel angle, channels T-sections for the support of piping or equipment shall be AISI-SAE 1020 low carbon steel or harder. Where piping is used for supports, it shall be Schedule 40 black steel.

2.02 CEILING, WALL AND FLOOR PLATES (Escutcheons)

A. Pipe Penetrations:

1. Hinged snap-on style. 3/4 Inch IPS and Smaller, Chromium plated brass. 1 inch IPS and Larger, Chrome Plated Steel. Sized to fit snugly around uncovered pipe, pipe covering, or sleeve extensions as each location necessitates.

B. Hanger Rod Entrance, Finished Room Ceilings

1. Spring ceiling plates. Chrome plated brass.

2.03 FLOOR AND WALL PENETRATIONS

A. Provide noncombustible seals around pipe penetrations for both new and existing construction at:

1. All Floors
2. Exterior Walls
3. Below-Grade Walls
4. 2-Hour and Greater Fire Rated Walls
5. Smoke Partition Walls
6. Where Designated by Code

B. Fire Rated Caulking Compound

1. Acceptable Manufacturers:

a. Dow Corning - Fire Stop
b. Standard Oil Engineering Materials Co. - Fyre Putty
c. 3M - Fire Barrier

2. Intumescent fire barrier caulk that provide seal against fire, smoke, toxic fumes and moisture.
3. Fire caulk shall provide a fire resistance to match the fire resistance of the wall or floor penetrated.
4. Fire caulk shall be UL listed and meet the testing requirements set forth by ASTM E-814-88.

C. Noncombustible pipe penetrations shall consist of:

1. Pipe sleeves.
2. Fireproof fill in annular space.
3. Surface sealing compound.
4. Provide pipe sleeves for the following:

a. All new construction.
b. Existing construction except where a smooth core drilled hole may be

obtained.

5. Pipe Sleeve Material:

    a. Concrete Construction:

        i. Steel pipe sleeve with square welded steel plate extending no less than 6" beyond sleeve, all rustproofed.

    b. All Other Floors and Walls:

        i. 26 Gauge Galvanized Steel Pipe

6. Pipe Sleeve or Core Drill Size:

    a. Diameter great enough to leave 1/2-inch clearance all around and shall be sized to allow pipe insulation to continue uninterrupted through the wall opening.

7. Pipe Sleeve Length:

    a. Length to suit wall or floor thickness.

        i. In walls, ends flush with each wall face.
        ii. Underside of floors, extend downward approximately 1 inch below bottom of floor surface.
        iii. Above floors, extend upward approximately 3 inch above finished floor surface.

8. Annular Space Filler For Pipes:

    a. Acceptable Manufacturers:

        i. Cheme Ind. - Gripper 1" - 8"
        ii. Thunderline - Link Seal
        iii. Instafoam - Front Pak

    b. Below-Grade Exterior Walls

        i. Mechanical seals consisting of synthetic rubber links with plated steel bolts and Delrin pressure plates that provide hydrostatic sealing.

    c. All Other Walls and Floors

        i. Fire rated caulking compound designed expressly for this

purpose.

ii. Mechanical seals described above.

2.04 SEALS, SAFING AND FLASHING

A. Wall and Floor Seals: Wall and floor seals shall be modular mechanical type with interlocking synthetic rubber links. Manufacturers/Models:

1.	Thunderline	No. 300, 400, 500 "Link-Seal"
2.	Clow	No. F-1430, F-1435
3.	Tyler	Nos. F-796, F-797

B. Roof Flashing:

1. Where plumbing vent penetrates roof and flashings must be attached to pipe, the flashing shall be 24 gauge galvanized metal.

C. Sealant:

1. Acceptable Manufacturers:

a.	General Electric	Silicone Construction 1200
b.	DAP	One Part Acrylic Sealant
c.	Dow Corning	Silicone Rubber Sealant

2. Caulking for exterior flashing shall be silicone or butyl rubber.
3. Caulking shall be capable of weathering in temperature ranging from -30 degrees F to 180 degrees F and in direct sunlight maintaining its elasticity and its adherence to the material on which it was applied.
4. Caulking color shall be black or where visible shall be chosen by the Construction Coordinator.

PART 3 EXECUTION

3.01 HANGERS AND SUPPORTS

A. Hangers in General:

1. All piping shall be supported as specified herein. All structural steel, hanger rods, turnbuckles, beam clamps, angle iron clips, inserts, brackets, floor bases, supports and bracing shall be provided.
2. Provide supports, where pipe changes direction, adjacent to flanged valves, strainers, and fittings and at equipment.
3. Horizontal suspended piping shall be supported with adjustable hanger assemblies. Provide the specified clevis type with weight bearing insulation and protection shield. All hanger rods shall have enough length and

threaded length to allow adjustment.

4. Vertical pipe runs shall be supported and laterally braced at every floor level. Support vertical pipe with riser clamps installed below hubs, couplings or lugs, welded to the pipe.
5. Piping shall be supported as follows:

	Maximum Spacing	
Pipe Sizes	Ferrous Pipe	Copper Tubing
2 inch - 1 inch	6 feet	5 feet
1-1/4 inch - 2 inch	8 feet	8 feet
2-1/2 inch - 3 inch	12 feet	8 feet
4 inch - 6 inch	14 feet	8 feet
8 inch - 14 inch	20 feet	---
Over 14 inch	As per Pipe Manufacturers Recommendations	

6. Piping shall be properly supported from hangers securely attached to the building construction using clamps for steel construction, anchors for concrete construction or lag screws or bolts for wood construction or as otherwise detailed on drawings or specified.
7. All piping shall be supported in a manner to minimize undesirable stress on bodies of valves and other fittings.
8. All piping shall be supported from walls on brackets, directly from the floor above, or from auxiliary steel. Do not support pipe from ceilings.
9. No cutting, drilling, welding or burning on any structural steel member shall be allowed. Power driven studs and welding studs shall not be allowed.
10. All bolts and threaded rods shall be used with double nut and washer or single nut, washer, and lock washer wherever a single unsecured nut could work loose and allow either threaded rod or supported piping to drop.
11. Cast in place concrete anchors shall be positioned and secured to reinforcing.
12. All Pipe hangers shall be cleaned and painted with rust resistant paint before installation.

3.02 PIPE MOVEMENT

A. Design and install hangers to resist disengagement from movement of supported pipe.

B. Provide allowances for expansion and contraction of installed piping. Install piping in a manner that will not cause more than negligible stress nor cause leaks due to thermal expansion and contraction. Movement of pipe shall not result in noise generation.

3.03 EQUIPMENT BASES

A. Provide for all floor mounted equipment reinforced concrete housekeeping bases

poured directly on structural floor slab 4" thick minimum, extended 6" minimum beyond machinery bedplates. All edges of the pad shall be chamfered. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. Contractor shall provide these concrete bases, coordinate with Contractor.

B. Concrete supplied for machine base and pad shall have a minimum compressive strength of 3,000 psi and be reinforced with 6 x 6 - W2.1 x W2.1 WWF.

C. Pads shall be doweled into slab floors with one 2 inch dowel rod per 6 square feet of pad, but not less than 4 dowels. Dowel shall project a minimum of 2 inches into the slab and 2 inches into the pad.

3.04 SUPPORT OF UNDERGROUND PIPING

A. Where fill or loose soil of shallow depth is encountered, over-excavate down to firm undisturbed earth and backfill to the proper elevation with bank sand or crushed stone compacted to provide a firm support for the pipelines.

B. Where deep fill or large areas of unstable soil is encountered, support the pipe at least every 10 feet - 0 inch (at each hub of cast iron soil pipe and cast iron water pipe) on concrete piers or concrete blocks with footings set on undisturbed earth, and fill the area between the piers with firmly compacted granular material.

C. At the foot of each plumbing riser, provide a concrete foundation with base set on solid earth for support of the stack.

D. Set all equipment bases, basins, and similar structures on solid undisturbed earth and provide substantial bases.

E. Where loose fill or unstable soil is encountered, provide concrete foundations, properly reinforced and carried down to firm bearing with footings set on undisturbed earth.

F. Design and construction of all bases and foundations must be reviewed by the Construction Coordinator.

3.05 CUTTING, DRILLING AND PATCHING

A. Contractor shall do all cutting and drilling that is required in order that its work may be properly installed and it shall do all patching and repairing required to restore all surfaces to their original condition.

B. Where holes are required, these shall be cut in a careful manner and the openings kept to an absolute minimum.

C. The cutting and drilling into structural members or slabs may be accomplished only upon the prior written concurrence of the Construction Coordinator.

D. Openings in a slab on grade shall be made by scoring with a concrete saw followed by a chiseled clean break. Such floor openings shall be restored using fully compacted granular subgrade and concrete bonded to the vertical pipe installed through the floor. No sleeve is to be placed in such case, and concrete shall be sloped upward around the pipe to prevent water ponding at that point.

E. All patching and repairing shall be done by experienced men in the particular trades to which the respective kinds of work belong; and shall be neatly made, restoring the area to its original condition to the satisfaction of the Construction Coordinator.

3.06 PRIMING

A. Prime coat exposed steel hangers and supports.

3.07 SLEEVES, SEALS, SAFING, FLASHING AND SEALANT

A. Wall and Floor Seals and Sleeves:

1. Setting:

a. Set sleeves in position in advance of concrete work.
b. Provide suitable reinforcing around sleeves.

2. Sleeves shall be cut the same length as the thickness of the walls and 1-1/2" longer than thickness of floors. 1-1/2" shall extend above the floor.
3. Cuts should be square or round and ground smooth.
4. In outside walls and in floors the annular space between the pipe and the sleeves shall be sealed with a flexible link seal as per this Specification.
5. In interior walls the annular space between the pipe and the sleeve shall be sealed tight with oakum.
6. Sleeves shall be sized with 2" of open space between outside pipe and inside of sleeve unless otherwise specified in individual sections.
7. Cuts between sleeves and walls or floors shall be patched with mortar to the approval of the Construction Coordinator.

B. Flashing:

1. Flashing for vent piping shall be soldered or lapped over vent piping and feather out on top of roof. Flashing should be sealed to roof with roofing pitch.
2. Wherever curbs or chimneys penetrate sloped roofs such that the joint formed by the curb or chimney and the roof is a straight line parallel to the ridge of the roof a cricket flashing shall be installed. Thus flashing shall be

sloped towards the sides of the curb or chimney at a minimum of 4/12 pitch such that no water may collect above the chimney or curb on the roof surface.

3. Flashing shall extend at least 8" underneath lapping roofing. On sloped roofs the lower flashing shall extend 8" over the top of the roofing and be secured with nails into wood, screws into sheet metal and anchors into concrete.
4. Nails, screws, anchor, and exposed flashing edges shall be covered and sealed with sealant as listed in this Specification.
5. Flashing attached to sheet metal shall be riveted into place with beads of sealant applied between the two metal surfaces and along the exposed edges.
6. All fasteners shall be of the same material as the flashing.
7. Caulking sealant shall not be used to fill gaps in flashing greater than 1/4". Gaps of this size shall be covered by flashing material, fastened and sealed into place.
8. Flashing, sealant and fasteners shall be painted a uniform color as per Construction Coordinator.

3.08 ADJUSTING AND CLEANING

A. Adjust hangers and supports and place grout as required under supports to bring piping and equipment to proper levels and elevations.

END OF SECTION 22 05 29

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PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes piping insulation for domestic water and drain and vent piping systems.

1.02 RELATED WORK

A. Section 22 10 00 – Plumbing.

1.03 REFERENCE TO STANDARDS

A. ASTM C553 - Standard Specifications for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial applications.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. ASTM E96 - Water Vapor Transmission of Materials.

D. NFPA 225 - Test of Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Submit shop drawings which indicate complete material data, list of materials proposed for this project and indicate K-value, and thickness of material for individual services.

C. Product Data

1. Insulation
2. Adhesives
3. Coatings
4. Jackets
5. Fasteners
6. Bands

1.06 REGULATORY REQUIREMENTS

A. National Fire Protection Association, NFPA: NFPA 255 - Test Methods Surface Burning - Building Materials.

1. Flame Spread: 25 or less.
2. Smoke Developed: 50 or less.
3. Fuel Contributed: 50 or less.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

1.08 PROJECT CONDITIONS

A. Perform work at ambient and equipment temperatures as recommended by adhesive manufacturer.

PART 2 PRODUCTS

2.01 PIPING INSULATION

A. Fiberglass Piping Insulation: Type P-1

1. Acceptable Manufacturers:

a. Manville Corp. - "Micro-Lok AP-T".
b. Owens Corning Fiberglas Corp. - "One Piece" 25 ASJ/SSII".
c. Certain-Teed - "500E Snap-ON".

2. Glass fiber, rigid molded sectional pipe covering, conforming to ASTM C547, Class II, Mineral Fiber Preformed Pipe Insulation".
3. Conductivity (k) equals approximately 0.23 BTU/HR.,SF.,EF per inch thickness at 75 degrees F.

2.02 INSULATION ACCESSORIES

A. Use the following accessories to install thermal insulations.

1. PVC Fittings Covers

a. Certain-Teed - "Snap Form"
b. Schuller Corp. - "Zeston"
c. Stauffer - "Ultra Jacket"

2. Vapor Barrier Lap Adhesive:

a.	Benjamin Foster	82-07
b.	Chicago Mastic	17-465
c.	Insul-Coustic	IC-215

3. Lagging Adhesive:

a.	Benjamin Foster	30-36
b.	Chicago Mastic	16-400
c.	Insul-Coustic	IC-102

4. Glass Cloth Jacket:

   a. Benjamin Foster
   b. Insul-Coustic
   c. Schuller Corp.
   d. Owens-Corning

5. Wire:

   a. Number 16 soft copper.

6. Insulation Bonding Adhesive (To Metal)

   a. Benjamin Foster 85-15
   b. Chicago Mastic 17-460
   c. Insul-Coustic I-C 201

7. Insulating and Finishing Cement

   a. Fibrex, Inc.- FBX Super Blend Cement
   b. Keene Corp. - Super Powerhouse
   c. Pabco Insulation

8. Mechanical Fasteners: Welded or adhered pins with speed clip washers.

   a. Gripnail Corp.
   b. Nelson Stud Co.
   c. Stik Klip Manufacturing Co.

9. Bands for Equipment

   a. Outside diameter of insulation is less than 24 inch: 1/2 inch x 0.020 inch (25 ga.) galvanized steel.
   b. Where diameter is 24 inches or larger: 3/4 inch x 0.020 inch.

10. Bands for Piping: 1/2 inch x 0.020 inch galvanized steel.
11. Wire Mesh: 1 inch by 20 gage galvanized hexagonal wire netting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested and approved before applying insulation materials. Do not apply insulation until piping has been leak tested.

3.02 PREPARATION

A. Verify that surfaces are clean, foreign material removed, and dry.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions. Slip insulation over pipe or slit insulation sections and apply around pipe. Seal longitudinal and circumferential joints with plastic contact adhesive.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperatures:

1. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Insulate fitting valves, with mitre-cut pieces. Seal all joints with plastic contact adhesive.
2. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
3. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
4. No further finish required.

D. For insulated pipes conveying fluids above ambient temperature:

1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Insulate fittings, valves with mitre-cut pieces.
2. For hot piping convey fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
3. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
4. No further finish required.

E. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: ASTM C640 cork, hydrons calcium silicate insulation, or

other heavy duty insulating material for the planned temperature range.

F. Finish insulation at supports, protrusions, and interruptions.

G. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with PVC jacket with seams located on bottom side of horizontal piping.

H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with PVC jacket with seams located on bottom side of horizontal piping.

3.04 GLASS FIBER INSULATION SCHEDULE

A. Plumbing Systems - mains, branches, risers, runouts, etc.

Roof Drain Piping	All pipe sizes	1"
Domestic Hot Water	All pipe sizes	1"
Domestic Cold Water	All pipe sizes	1"
Condensate Drain Piping	≤ 1"	1/2"
	1-1/8" thru 2 1/2"	3/4"

B. Plumbing Vents within 6 lineal feet of the exterior.

1. Thickness: 1/2" min. (adequate to prevent condensation under all operating conditions.)

END OF SECTION 22 07 19

DIVISION 22 – PLUMBING
Section 22 10 00 – Plumbing

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes the furnishing and installing of the plumbing fixtures and small diameter piping required for the potable and non-potable water systems.

1.02 RELATED WORK

A. Section 22 05 29 – Sleeves, Supports, Hangers, Anchors and Seals.
B. Section 22 07 19 – Piping Insulation.
C. Section 22 10 19 – Plumbing Specialties.
D. Section 22 30 00 – Plumbing Equipment.
E. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCE TO STANDARDS

A. All plumbing shall be installed in strict accordance with the latest edition of the "Illinois State Plumbing Code".

B. If, in the opinion of the Contractor, there is anything in the plans or specifications that will not strictly comply with the above laws, ordinances and rules, the matter shall be referred to the attention of the Construction Coordinator for a decision before proceeding with that part of the work. No changes on the plans or in the specifications shall be made without the full consent of the Construction Coordinator.

C. The Contractor shall obtain and pay for all licenses, permits and inspections required by the above laws, ordinances and rules for the entire plumbing job called for in these specifications and the accompanying plans.

1. ASME - Boiler and Pressure Vessel Code.
2. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
3. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
4. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
5. ASTM A74 - Cast Iron Soil Pipe and Fittings.
6. ASTM B32 - Solder Metal.
7. ASTM B88 - Seamless Copper Water Tube.
8. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
9. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
10. ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

11. ASTM D2564 - Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
12. ASTM D2665 - Polyvinyl Chloride (PVC) Pipe.
13. AWWA C651 - Disinfecting Water Mains.

14. ASTM D4101 – Specification for Polypropylene Plastic Injection and Extrusion Materials

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 00 13 30 – Submittal Procedures.

B. Shop drawings of all the plumbing fixtures and equipment shall be submitted to the Construction Coordinator for review.

1.05 WARRANTY

A. The fixtures and equipment and their installation are subject to the one-year warranty provisions of the General Conditions.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Refer to Division 2 – SITEWORK.

2.02 SANITARY SEWER AND VENT PIPING, BURIED TO WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785, Schedule 40.

1. Fittings: ASTM D2466, Schedule 40 socket type.
2. Joints: Socket-weld using PVC solvent cement conforming to ASTM D2564.

2.03 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

A. PVC Pipe: Dual marked ASTM D1785 and ASTM 2665, Schedule 40.

1. Fittings: ASTM D2466, Schedule 40 socket type.
2. Joints: Socket-weld using PVC solvent cement conforming to ASTM D2564.
3. Piping located in air plenum shall be insulated with 1/2” type P-1 insulation or other “fire wrap” material accepted by the local code authority that would provide compliance with NFPA 255 - Test Methods Surface Burning -

Building Materials.

2.05 WATER PIPING

A. Copper Tube: ASTM B88, Annealed Temper.

1. Type L – hard drawn above grade, Type K – hard drawn or soft rolled below grade and for all plant water service.
2. Fittings: wrought copper solder-joint, ANSI B16.22, Streamline Pattern.
3. Joints: 95-5 Tin-Antimony Solder-Type, Lead free.

a. ASTM B 813 - 93, Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
b. ASTM B 813 - 93, Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.

2.06 FLANGES, UNIONS AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous pipe: 150-psig malleable iron threaded unions.
2. Copper tube and pipe: 150-psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16-inch thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16-inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contractions, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing gasket.

2.07 VALVES

A. All valves shall be supplied with brass identification tags supplied by manufacturer. All valves shall be same size as connected piping except as noted otherwise.

B. Gate Valve, Non-Ferrous Pipe Material, All Sizes:

1. Acceptable Manufacturers:

a. Hammond IB629
b. Nibco Number T134
c. Walworth Number 11

2. Bronze body, union bonnet, bronze mounted gate or wedge style. Rising stem handwheel operated, open CCW, conventional packing gland, re-packable under pressure. Pressure rating: 150 psi WSP; 300 psi WOG. N.P.T. screw ends, ANSI B2.1.

C. Gate Valve, Ferrous Pipe Material, 2 Inch IPS and Smaller Sizes:

1. Acceptable Manufacturers:

a. Hammond IB629
b. Nibco Number T134
c. Walworth Number 11

2. Bronze body, bronze mounted gate or wedge style. Rising stem, handwheel operated, open CCW, conventional packing gland, re-packable under pressure. Pressure rating: 150 psi WSP; 300 psi WOG. N.P.T. screw ends, ANSI B2.1.

D. Ball Valves, All Pipe Material, All Sizes

1. Acceptable Manufacturers:

a. Milwaukee BA100/BA150
b. Nibco 585
c. Hammond Series 806/807

2. 2-Piece Bronze body with brass trim. Chromium plated brass ball with TFE seats. Lever Handle. Stem extension to clear insulation covering jacket (if required). Pressure Rating: 600 psi WOG. Threaded or solder connection as determined by type of pipe.

E. Swing Check Valves, Horizontal Piping, All Pipe Material:

1. Acceptable Manufacturers:

a. Hammond IB946 / IR1124.
b. Nibco T-433-Y / F918B
c. Walworth 3412/8928F Series

2. Bronze body Y pattern 2 inches and smaller; iron body 2-1/2 inches and larger. Renewable discs and seats.

F. Angle Valves, Plumbing Fixture Supply:

1. Acceptable Manufacturers:

a. American Standard 8253.011
b. Eljer 801-0796
c. Kohler K-7666

2. Wheel or 4 arm handle. Brass body, polished chromium plated.

2.08 THERMOMETERS

A. Acceptable Manufacturers:

1. Marshalltown, Figure 254
2. Tel-Tru Manufacturing, Model AA-565R
3. Weiss Instruments Inc.

B. Provide thermometers with, 5 inch diameter dial thermometer, stainless steel case with glass face, black numerals on white face, hermetically sealed, vibration dampened, one percent accuracy, bi-metallic actuation graduated in (EF), range depending on application, variable angle stem-case connection, separable sockets.

2.09 PIPE IDENTIFICATION MARKERS

A. Acceptable Manufacturers:

1. W.H. Brady Company Z400 Indoor
2. Seton Name Plate Corporation Set Mark
3. Craftmark Identification Systems

B. Provide identification markers to identify piping in accord with the State of Illinois Standard Color Code for Piping Identification. Identification markers shall be all-temperature vinyl printed cloth markers with adhesive back or acrylic plastic "snap around" style for application on insulated and bare piping. Letters on markers for use on 3-inch and larger diameter pipe shall be 2-inch high and letters for markers for use on pipe less than 3-inch diameter shall be 1-inch high. Flow shall be indicated by directional arrows adjacent to lettering. Apply markers after painting.

2.10 SHOCK ABSORBERS

A. Acceptable Manufacturers:

1. Josam Absorbotron
2. Jay R. Smith Hydrotol
3. Wade Shokstop
4. Zurn Shoktrol

B. Shock absorbers shall have sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Stainless steel body and bellows. Factory pre-charged compression chamber. Absorbers shall have been tested and certified in accordance with Plumbing and Drainage Institute Standard WH-201.

2.11 BACKFLOW PREVENTERS

A. Reduced Pressure Principle (RPZ) Type

1. Acceptable Manufacturers:

a. Wilkins 975, 975XL
b. Watts 909
c. Conbraco Series 40-200
d. Febco

2. Reduced pressure principle backflow preventer with test valves. Provide strainer upstream of and bronze ball valves or cast iron gate valves on both sides of backflow preventer. Provide air gap, drain fitting and pipe open sight to nearest drain.

3. Unit shall be ASSE listed 1013, AWWA compliant, UL listed and FM approved.

2.12 THERMOSTATIC MIXING VALVE: TMV-1

A. Acceptable manufacturers - subject to compliance with specifications:

1. Leonard Model 210-SB
2. Symmons Temp Control
3. Lawler Series 4000

B. Provide thermostatic mixing valve for hot water (110°F Adj.) supply to public lavatories.

C. Maximum operating pressure: 125 psi.

D. Solid bi-metal thermostat directly linked to valve porting to control the intake of cold

and hot water.

E. Combination straight checkstops on inlets.

F. Copper tube connections.

G. Minimum flow: .5 gpm.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 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.

D. Install piping to conserve building 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.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure no less than 3 and one-half feet of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 09910.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, no inverted valves will be permitted.

N. Vent pipe flashing shall extend all around the pipe onto the roof a minimum of 12 inches in all directions. The flashing shall be carried up, over, and down into the pipe at least 2 inches. Provide and secure flashing ring to roof.

O. Shut-off valves shall be installed to isolate sections of the pipe and fixtures for repairs and maintenance, and in the risers and main branches at points of take-off from their main supplies, even when not indicated on the drawings.

P. Install specialties in accordance with manufacturer's instructions and the Illinois Plumbing Code.

Q. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

R. Encase exterior cleanouts in concrete flush with grade

S. Pipe relief from back flow preventer to nearest drain.

T. Provide cleanouts where shown on drawings and where required by the Illinois Plumbing Code.

3.03 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball valves for throttling, bypass, or manual flow control services.

3.04 ERECTION TOLERANCES

A. Drainage and Vent Pipes

1. Unless shown on the drawings, horizontal soil and waste pipes 4 inches and larger in diameter shall have a minimum grade of 1/8 inch per foot, and less than 4 inches in diameter shall have minimum grade of 1/4 inch per foot. Main vertical soil and waste stacks shall be extended full size to the roofline and above as vents, except that the minimum size vent through roof shall be 3 inches.
2. Where practicable, two or more vent pipes shall be connected and extended as main vent riser above vented fixtures. Where a circuit vent pipe from any fixture or line of fixtures is connected to a vent line serving other fixtures, the connection shall be at least 6 inches above the flood level rim of the waste. Vent and branch vent pipes shall be so graded and connected as to drip back to the vertical stack of gravity.

B. Water Supply Piping

1. Grade horizontal piping at uniform slope of 1/8 inch in 10 feet, or as indicated to low points of the system for emptying the piping of water when needed. Where constant pitch cannot be maintained for long runs, establish intermediate low point and rise to new level. Grade branches to drain to main or riser. At bottom of the riser and at low points, provide and install 1/2-inch brass valves with capped nipple. Where fixtures are connected to risers at lowest level, they may be considered as drains.

3.05 INSTALLATION OF SHOCK ABSORBERS

A. Provide shock absorbers on all hot and cold water lines where indicated on the Drawings.

B. The letter designation of the shock absorbers that are indicated refers to PDI symbols for the classification of shock absorbers as set forth in PDI-Standard WH201.

3.06 VENT STACKS THROUGH ROOF

A. Extend stacks at least 12 inches above finished roof.

B. Provide pipe increaser immediately below roof, installed so upper end is one pipe size larger than stack.

3.07 DISINFECTION OF WATER SYSTEM

A. Disinfect the domestic supply and distribution system, and have such system proven free from pollution-causing growths or organisms, before the system can be considered useable. Such disinfection may be accomplished piecemeal, on segments

of the overall system as they approach completion, or on the entire system at one time.

B. Disinfection agent and technique shall be in accordance with the Illinois State Plumbing Code, (latest edition).

C. Provide the disinfection agent, mixing containers, solution pump, accessory equipment and materials, and manpower for disinfection. Notify the Construction Coordinator at least 24 hours before any disinfection procedure is scheduled and an Construction Coordinator's representative will observe the procedure. Provide sampling and laboratory testing.

D. The disinfecting agent shall be granular or powdered calcium hypochlorite, diluted to a solution of 50 milligrams per liter of water. Solution shall be pumped from its drum or other container into the upstream end of the section or system being disinfected, through a disconnected union, unfinished pipe end, or fixture already in place. After the section or system is full of solution and trapped air is purged, the solution shall be held in the pipeline and accouterments for at least 6 hours. During this time, all valves in the section being treated shall be operated from fully open to fully closed to open again, and pump impellers shall be rotated manually.

E. After retention of disinfecting solution for the designated interval, the upstream end of the section being treated shall be connected in its permanent manner, and the section or system shall be flushed with water supplied from the City main. Samples of water that have flowed through the entire treated section or system shall then be collected for laboratory bacteriological analysis.

F. The system will be considered adequately disinfected when samples collected on 2 consecutive days result in laboratory tests that indicate no evidence of pollution. When repeated test show presence of pollution, repeat the disinfection procedure, until acceptable results are obtained.

G. Alternate agents and methods may be used subject to prior written approval of the Construction Coordinator.

3.08 FINAL CLEAN UP

A. After completion of the plumbing installation, flush out the entire system and thoroughly clean to remove all grit, oil, and foreign materials from the piping.

B. Clean all paint, grease, oil, dirt, labels, stickers, from all fixtures, equipment and exterior of the piping.

C. Wash and polish all plumbing fixtures, clean and polish all plated surfaces and touch up all mars and scratches on painted and enameled finishes.

D. Clean all grates and strainers on all floor and roof drains.

E. All surplus materials, debris and tools shall be promptly removed from the premises and all damage to other work promptly made good.

3.09 ELEVATIONS, GRADES AND LINES

A. Pipe Bury

1. Where definite grades, elevations or profiles are not indicated on the Drawings, install pipelines at the following depths, top outside center pipe to finish ground surface:

Fluid in Pipe	Minimum Earth Cover
Water	4 feet - 8 inch
Waste, storm and sanitary	2 feet - 6 inch
Gas	1 foot - 6 inch

3.10 EXCAVATING AND BACKFILLING

A. Contractor's Responsibility:

1. Contractor is responsible for the excavation and backfilling necessary for installation of his work.
2. Perform excavation of every character of sub-surface material encountered, including frangible rock, solid rock, rubble, existing foundations, footings, bases, fluid sand, and muck. The nature of material excavated is not cause for charge in lump sum price.
3. Provide sheathing and bracing as required for protection of workmen, for protection of work installed in the excavation and for compliance with regulatory agency rules.
4. Remove and dispose of surplus excavated material, away from the premises, in a manner that conforms with local regulations. Any surplus earth or materials not removed promptly by the Contractor will be removed by others as directed by the Construction Coordinator and the cost of the removal charged to the Contractor.

B. General

1. Excavation and backfilling in streets and parkways shall be in accordance with the requirements of the City or governing body having jurisdiction.
2. Excavations are to be conducted that no walls or footings are disturbed or injured and with a minimum of disturbances to the subgrade.
3. No power trenching equipment will be permitted inside the building lines, except upon written permission of the Construction Coordinator.

4. Maintain all trenches and excavations free of standing water. Provide all pumping equipment, labor and energy for operating same.
5. Divert dewatering apparatus discharge to natural drainage courses, curbs or storm sewers, not to sanitary sewers.
6. Fill materials, fill placement and compaction procedures are subject to the approval of the Construction Coordinator.
7. If cinder fill is unexpectedly encountered, notify the Construction Coordinator. All pipe and conduits installed in cinder fill shall be encased in six (6) inch thickness of 3000 PSI, normal weight concrete.
8. No piping or other work shall be covered until inspected, tested and reviewed by the Construction Coordinator.

C. Pipeline trenches below concrete slabs on grade or paved area.

1. Excavate 4 inches deeper than planned outside bottom center of pipe.
2. Place a layer of bank sand, or approved equivalent, 4 inches nominal thickness, between trench bottom and pipe to act as uniform support pad and spacer.
3. Fill around and over installed pipe with compacted sand or other approved granular material to underside of concrete slab or base course.
4. Backfill material shall be placed in successive 8 inch thick layers and each layer compacted by pneumatic or mechanical tampers to 90 percent of maximum dry density as established by Modified Proctor Test (ASTM D-1557) for cohesionless soils and 90 percent for cohesive soils.

D. Pipeline trenches through unpaved areas.

1. Provide pipe bedding and backfill material as specified in preceding subparagraph, except that backfill shall terminate 9 inches from the top of the trench excavation.
2. The top 9 inches of the excavation shall be restored with a material type to match the existing materials.
3. In the case of trenching through natural earth or previously backfilled areas, the backfill shall be compacted and mounted 6 inches above existing grade to allow for settlement.

3.11 PIPE JOINTING

A. Cleaning:

1. Care shall be taken to keep pipe compound and all other foreign matter from entering the interior of the piping. Each section of pipe and all fittings shall be carefully inspected for dirt, grease, or other foreign matter on the inside. They shall be properly cleaned before assembly.

2. Thoroughly clean the piping systems after completion to the satisfaction of the Construction Coordinator.

B. Threaded Pipe:

1. Acceptable Manufacturers:

a. Hercules - TFE Pipe Joint or Real Tuff
b. Markal Company
c. Rector Seal - 100% Virgin

2. Threads shall be full and clean cut, and ends of pipe shall be reamed.
3. When screwed joints are assembled, the male thread shall be thoroughly coated with jointing compound to serve as a joint sealer and as a primer for the exposed threads.

C. Bell and Spigot Joints:

1. Joints in bell and spigot cast iron soil pipe shall be made by ramming a ring of oakum into the bell to within 1-1/2 inches of the face of the bell. The bell then shall be poured full at one pouring with molten lead and caulked tight. Trim lead flush with the end of the bell.
2. Compression type joints for bell and spigot cast iron soil pipe made with approved type neoprene insert gaskets.

D. No-Hub Soil Pipe Joints:

1. Joints shall be made with a neoprene gasket covered by a corrugated metal stainless shield secured by two (2) or more stainless steel bands or clamps.

E. Copper Tubing Joints:

1. Brazed Joints

a. Solder: 95-5 on all lines.
b. Clean mating surfaces of tube and fitting to bright sheen and apply flux.
c. Apply solder and heat until the molten solder is drawn into the joint by capillarity and the connection is tight.

F. Socket Fusion Welds: Contractor to use manufacturer's recommended heat tool to create fusion weld.

3.12 THERMOMETER INSTALLATION

A. Install thermometers in piping and equipment in solid bar Thermowells filled with non-solidifying heat conduction paste.

B. Well material appropriate for type of service, temperature and fluid velocity.

C. Wells shall be located in path of moving liquid, not in stagnant or dead end positions.

D. Wells shall not obstruct flow.
E. Wells on pipes one-inch diameter and smaller shall be increased one pipe size.

F. Provide extension necks on thermometers installed in insulated piping or equipment.

3.13 PIPE MARKER INSTALLATION

A. Provide pipe markers on all "exposed" and "concealed but accessible" insulated and bare plumbing pipelines.

B. Pipe markers shall be located as follows:

C. On straight runs of pipe at intervals not exceeding 50 feet.

D. At every sectionalizing or main shut off valve.

E. All plumbing piping exposed by access panels.
F. All plumbing piping mains in accessible chases.

G. On each riser at a point 5 feet above floor or platform.

H. At least once in every room the piping passes through for rooms less than 30 feet long in that direction.

I. For rooms longer than 30 feet, on both sides of a wall or partition through which pipe passes and at intervals not exceeding 50 feet.

J. Markers shall be applied so they can be read when standing on the floor.

3.15 INSPECTION AND TESTING

A. All piping systems shall be tested for leaks and subject to Architect/Engineer's written approval before covering is applied and before backfilling or concealing within the structure.

B. Notify the Architect/Engineer and Owner, three working days before the tests are to be made. Concealed work shall remain uncovered until specified tests have been completed; when necessary, tests on portions of the work may be made so that those

portions of the work may be concealed after being proven satisfactory. Repairs or defects that are discovered as a result of inspection or tests shall be made with new materials. Caulking of screwed joints, cracks, or holes will not be accepted. Tests shall be repeated until all defects have been eliminated. Furnish the equipment, material, and labor to accomplish the tests.

C. A water pressure test shall be applied to all parts of the drainage systems, before the pipes are concealed or fixtures set in place. The test may be applied in sections. All openings of each system to be tested shall be tightly closed except the highest openings above the roof and the entire system or sub-system shall be filled with water up to the overflow point of this highest opening. All parts of the system shall be subjected to not less than 10 feet of hydrostatic head except the uppermost 10 feet of the piping directly below the opening. The water shall remain in the system for not less than 30 minutes after which time no leaks at any joints or lowering of the water level at the overflow shall be visible.

D. Cap all open connections in the water piping systems and fill the sections of piping to be tested with water at 100 pounds per square inch gauge pressure registered at ground floor level. The system shall be carefully inspected and all defective material replaced and leaks repaired. The test pressure shall be held for a minimum period of 1 hour without variation in pressure except that which is due to changes in temperature.

E. Cap up all open connections in the gas piping system. A suitable air chamber shall be attached to the system and compressed air introduced until a pressure of 125 pounds per square inch is reached. The system shall be isolated before the test begins. The test pressure shall be held for a minimum period of 1 hour without variation in pressure except that which is due to changes in temperature.

F. Welding piping shall be subject to a hydrostatic test of not less than 100 pounds per square inch, or 1-1/2 times the working pressure, which ever is the greater at which pressure all welded joints shall be hammered with a three pound hammer, the blows being struck with a sufficient force to jar the pipe and joint, but not so hard as to injure the piping. All welds shall pass this test without showing leaks or any defects.

END OF SECTION 22 10 00

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes requirements to furnish and install all plumbing specialties required for complete plumbing systems.

1.02 RELATED WORK

A. Section 22 10 00 – Plumbing.
B. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCES TO STANDARDS

A. ANSI A112.21.1 - Floor Drains.

1.04 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer shall certify to not less than five (5) years in the manufacture of items specified.
B. Conform with State and local Plumbing Code.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site per manufacturer's recommendations.

B. Accept specialties on site in original factory packaging. Inspect for damage.

C. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 FLOOR DRAINS

A. FD-1

1. Acceptable Manufacturers

a.	Wade	W-1100
b.	Zurn	ZN-415-5B
c.	Josam	30000
d.	Smith	2010

2. Cast iron body with 4" bottom outlet, combination invertible membrane clamp and adjustable collar with 5" diameter polished nickel bronze strainer. Provide separate seal trap with cast iron body.

2.02 FLOOR CLEANOUTS

A. Acceptable Manufacturers

1.	Wade	W-6000
2.	Zurn	Z-1400
3.	Josam	56010
4.	Smith	4020

B. Cleanouts on buried piping shall be brought up to floor level as shown on the drawings. Diameter shall be same as pipe size up to 4" I.P.S. Diameter shall be 4" on pipes sized grater than 4" I.P.S.

C. Apply teflon paste thread lubricant to male threads of all cleanout plugs in strict accordance with the manufacturer's recommendations.

D. Cast iron adjustable floor cleanout with threaded adjustable housing, flanged ferrule spigot outlet, bronze taper plug, and round nickel bronze scoriated cover.

2.03 WALL CLEANOUTS

A. Acceptable Manufacturers:

1. Wade 8460-R

2. Zurn Z-1441
3. Josam 58790
4. Smith 4530

B. Cleanouts in vertical drainage lines shall be installed perpendicular to wall surface. Diameter shall be same as pipe size up to 4" I.P.S. Diameter shall be 4" on pipes sized greater than 4" I.P.S.

C. Apply teflon paste thread lubricant to male threads of all cleanout plugs in strict accordance with the manufacturer's recommendations.

D. Cast-iron wall cleanout with bronze tapered thread plug tapped and threaded for cover screw. Cleanout shall have a stainless steel round cover secured to plug with a stainless steel screw.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of floor construction to receive drains and cleanouts to required invert elevations.

3.02 INSTALLATION

A. Install items in this section in accordance with manufacturer's instructions and in conformance with state and local plumbing codes at the locations indicated on the drawings.

B. Extend cleanouts to finished floor surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure 18" clearance at cleanout for rodding of drainage system.

C. Connections at right angles to ends of lines shall be made with long radius quarter bends or two eights bends.

D. Connections at right angles to runs of horizontal lines shall be made with wye and eighth bend and eighth bend.

E. Cleanouts shall be full size of pipe served but need not be larger than 4" inside building or 6" outside building.

F. Install flashing and clamping device on all cleanouts above slab on grade.

G. Fasten floor drains to floor and install flashing except when drain is installed in slab-on-grade.

H. Adjust floor drain strainer grate to be flush with floor. Grate shall be level and true to wall lines.

I. Field coordinate exact location of floor drains with equipment.

J. At substantial completion, fill floor drain traps with clean mineral oil.

END OF SECTION 22 10 19

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This section includes requirements to furnish and install pipe materials, fittings, and valves for natural gas systems from the utility meter to the natural gas fired equipment.

1.02 RELATED WORK

A. Specified elsewhere:

1. Division 23

1.03 REFERENCE TO STANDARDS

A. ASME - Boiler and Pressure Vessel Code.

B. NFPA 54 - National Fuel Gas Code.

C. NFPA 58 – Liquefied Petroleum Gas Code.

C. International Mechanical Code

D. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless, for ordinary uses.

E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

F. ANSI B31.2 - Fuel Gas Piping.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only toa recognized material supplier who has been furnishing materials in the same area as project for a period of

not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Provide coordination drawings indicating pipe routing, attachments and connections to equipment.

C. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information.

1.06 REGULATORY REQUIREMENTS

A. Perform work in accordance with State and local building codes.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept material on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. 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

2.01 GAS PIPING SYSTEM

A. Above grade piping, Contractor shall use the following:

1. Steel Pipe: ASTM A53 or A120, Schedule 40 Black.

    a. Fittings: ASME B 16.3, malleable iron, or ASTM A234, forged steel welding type.
    b. Joints: NFPA 54, Threaded or welded to ANSI B31.1

B. Below grade piping, Contractor shall use the following:

1. Plastic Pipe:

    a. ASTM 2513 pipe specially manufactured for underground gas piping.
    b. Fittings: Fittings shall be approved for fuel-gas piping systems and compatible with the pipe or tubing.

2.02 GAS COCKS

A. Lubricated plug cock.

1. Acceptable Manufacturers:

    a. Homestead Number 601
    b. Powell Number 2202
    c. Walworth Number 1700

2. Full port, semi-steel body, N.P.T. screwed ends.
3. Pressure rating: 200 pounds per square inch WOG.
4. Lubricant:

    a. Compatible with natural and liquefied petroleum gas.
    b. Provide 2 spare sticks per valve.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify excavations under provisions of Division 2 – Site Construction.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with the manufacturer's instructions, all state and local codes and as described herein and shown on the Drawings. Coordinate installation with gas supplier.

B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building 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 pipes, joints, or connected equipment.

G. Provide access where valves and fittings are not exposed.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Install valves with stems upright or horizontal, not inverted.

J. Shut-Off Valves: Installed to isolate sections of the pipe and fixtures for repairs and maintenance, and in the risers and main branches at points of take-off from their main supplies, even when not indicated on the drawings.

K. Install unions downstream of valves (if valves do not have unions) and at equipment or apparatus connections.

L. Installation of gas piping or appliance shall be performed only by qualified installing agency as defined by the National Fuel Gas Code, NFPA Number 54. All procedures, methods and, materials shall comply with specified portions of NFPA 54.

M. While installing gas piping, take all precautions to prevent damage to property and injury to persons. Comply with all regulations and specified codes and the gas utility company.

N. Pitch all horizontal gas piping downward in the direction indicated on the drawings not less than 1/4 inch in 15 feet toward a drip trap. Provide dirt legs at low points in the system and at major pieces of equipment.

O. Securely close each outlet gas-tight with a threaded plug or cap immediately after installation and keep closed until an appliance or gas fired piece of equipment is

connected. When a gas fired piece of equipment or appliance is disconnected from an outlet, the outlet must be securely closed gas-tight.

P. Immediately after turning on the gas, inspect the piping system using a gas meter and methods described in NFPA - Number 54. When a leak is found, shut off the gas until the leak is repaired. The test shall then be remade until no leakage is detected.

Q. After piping has been inspected, fully purge all gas piping. To purge the gas piping to a piece of equipment, disconnect the pilot piping at the outlet of the pilot valve. Do not purge piping into a combustion chamber of an appliance or into a confined space where sources of ignition exist or there is no positive means of ventilation.

R. Locate LP gas tank a minimum of 25 feet away from the building.

3.04 PIPE HANGERS AND SUPPORTS

A. General

1. All piping and pipe-connected equipment, including valves, meters, etc., shall be supported in a manner to prevent vibrations in the building structure.
2. Valves and other equipment requiring removal for maintenance and repair shall be supported in such a manner that additional support of the pipe will not be required when the items are removed. Inserts for attachment to concrete work shall be set before the concrete is poured. Attachments to existing concrete and masonry work shall be by use of anchor bolts with expansion shields, toggle bolts, and other means as shown or approved. Auxiliary structural steel shall be prime painted before installation.

B. Horizontal Supports - Except as otherwise indicated on the Drawings, horizontal pipe shall be supported at intervals not to exceed the following:

Material	Size	Maximum Space (ft.)
Steel	1" - 1-1/2"	6' - 0"
	Over 1-1/2"	10' - 0"

C. Supports shall be manufactured by F & S, Grinnell, Elcen, B-Line, or equal. Supports for piping shall consist of PVC or galvanized brackets; stainless steel or cadmium plated hardware and galvanized or zinc plated threaded rods. Supports for use with copper pipe shall be copper, brass, or copper-clad. Rods shall not be less than 3/8" in diameter.

3.05 TESTING

A. Prior to acceptance and initial operation, all piping installation shall be inspected and tested to determine that the materials, design, fabrication and installation practices

comply with the requirements of NFPA 54.

B. Test medium shall be air, nitrogen or carbon dioxide.

C. Pipe joints, including welds, shall be left exposed for examination during the test.

D. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Prior to testing, the interior of the pipe shall be cleaned of all foreign material.

E. Test pressure shall be measured with a manometer or with a pressure measuring device designed and calibrated to read, record or indicate a pressure loss due to leakage during the pressure test period. The pressure source shall be isolated before pressure tests are made.

F. Test pressure shall be no less than 1-1/2 times the proposed maximum working pressure, but not less than 3 psig.

G. Test duration shall be not less than 2 hour for each 500 cubic feet of pipe volume.

END OF SECTION 22 11 23

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section includes requirements to furnish and install the following plumbing fixtures:

1. Water Closets.
2. Lavatories.
3. Service Sinks.
4. Sinks.
5. Urinals.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 22 10 00 – Plumbing.
2. Section 22 10 19 – Plumbing Specialties.
3. Section 22 30 00 – Plumbing Equipment.

1.03 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.

D. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).

E. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.

F. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

1.04 SUBMITTALS

A. Submit in accordance with Division 1.

B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions,

utility sizes, carriers, trim, and finishes.

C. Manufacturer's Installation Instructions.

D. Maintenance Data: Include fixture trim exploded view and replacement lists.

1.05 QUALITY ASSURANCE

A. Manufacturer shall have no less than five (5) years experience.

B. Conform to State and Local Plumbing Code.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site per manufacturer's recommendations.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 EXTRA MATERIALS (SPARE PARTS)

A. Provide two of each model faucet washers or valve repair kits, and two of each model flush valve service kits.

PART 2 PRODUCTS

2.01 WATER CLOSETS, WC-1 TANK TYPE WATER CLOSETS:

A. All water closets shall have the following features unless described differently in specific water closet specification paragraph.

1. White vitreous china elongated bowl.
2. Water saving flush design.
3. Passageway for 2-1/2 inch sphere, minimum.
4. Open front, anti-microbial, white seat with self-sustaining stainless steel check hinge, less cover.
5. Open front anti-microbial, white seat with self-sustaining stainless steel check hinge with cover for handicapped water closets.
6. All exposed pipe, valves, fittings shall be chromium plated.

B. WC-1:

1. Acceptable Manufacturers - Subject to compliance with the specifications:

   a. American Standard #2998.012 Cadet ADA
   b. Gerber
   c. Kohler
   d. Eljer
   e. Zurn

2. Siphon jet flushing action.
3. Tank type, floor mounted, bottom outlet.
4. Flush tank, close-coupled.
5. Anti-siphon float valve, chromium plated trip lever, and flush valve.
6. Chromium plated loose removable key angle valve stop on supply pipe.
7. Open front seat made of anti-microbial plastic.
8. Low consumption 1.6 gpf.

C. Seat

1. Acceptable Manufacturers - Subject to compliance with the specifications:

   a. Bemis
   b. Church
   c. Olsonite
   d. Beneke

2. Solid white, anti-microbial plastic, elongated type, open front, extended back, handicapped seat, top of seat at 17” to 19” above finished floor, with self-sustaining stainless steel check hinge, brass bolts, less cover. Maximum thickness 1-1/2 inches.

2.02 WALL HUNG LAVATORY, LAV-1

A. Basin

1. Acceptable Manufacturers:
   a. American Standard Lucerne 0356.015
   b. Eljer Delwyn 051-1848
   c. Kohler Greenwich K-2030
   d. Gerber Monticello 12-458
   e. Zurn

2. ANSI/ASME A112.19.2; 20 inch x 18 inch white vitreous china body. Single hole faucet penetrations. Rigid chromium plated supply pipes. Chromium plated angle stop valve on each supply pipe. Grid drain with perforated strainer and chromium plated, cast brass, 1 1/4" offset tailpiece and P-trap. Mounting height at each location is dimensioned on the

Architectural Drawings, or as directed by the Architect/Engineer.

B. Faucet

1. Acceptable Manufacturers – Subject to compliance with the specifications:
   a. American Standard #2000.101X
   b. Chicago Faucet2200-CP
   c. Delta

2. ASME A112.18.1M; All metal construction chrome plated, ceramic mixing cartridge, deck mounted for sink with single faucet hole, single lever handle lavatory faucet less waste, 3/8" O.D. copper inlets and vandal resistant water economy aerator. Unit shall be ADA compliant.

C. P-Trap and Supply Pipe Insulation

1. Acceptable Manufacturers:
   a. Truebro Lavguard
   b. Brocar Trap Wrap
   c. McGuire Pro Wrap
   d. TCI Products Skal Gard

2. Drain and supply pipes shall be covered with protective pipe covering. Covering to be molded, anti-microbial, closed cell vinyl. Supply pipe covers shall give access to angle stop valve handles without damaging covers.

2.02 URINAL, UR-1

A. Bowl

1. Acceptable Manufacturers:

   a. American Standard 6501.010 "Washbrook"
   b. Gerber 27-780 "Monitor"
   c. Kohler K-4960-T
   d. Eljer 161-1030 "Correcto"
   e. Zurn

2. ANSI/ASME A112.19.2; White vitreous china wall hung, wash-out type, with water saving (1.0 gallon) flush design. 14" extended rim, 3/4" top spud, 2 inch outlet. Fittings and hardware all chromium plated. Mounting height is indicated on Drawings, or as directed by the Architect/Engineer. Exposed pipe, valves, fittings shall all be chromium plated.

B. Flush Valve

1. Acceptable Manufacturers:

   a. Sloan "Royal" 186-1
   b. Zurn "Aquaflush" Z-6003XL-WS1
   c. Delaney

2. ASME A112.18.1; Chrome plated, exposed diaphragm type flush valve with vacuum breaker and screw driver stop with protective cap, escutcheon, two wall bumpers and oscillating handle. Maximum 1.0 Gallons per flush cycle.

C. Concealed Floor Mounted Carrier

1. Acceptable Manufacturers:

   a. Wade
   b. Zurn
   c. Josam
   d. Smith

2. ANSI/ASME A112.6.1; Universal carrier with 1-1/4 inch Schedule 40 steel pipe supports(2 required) with cast iron block feet, lugs for floor and wall attachment, wall plate with adjustable threaded fixture studs with nuts and washers.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions. Plumbing fixtures shall be set and connected to soil, waste, and vent and cold and hot water supplies in a neat, finished and uniform manner, in accordance with state and local plumbing codes.

B. Install components level and plumb. Fixtures of each class and the connection to some shall be of equal height, plumb and at right angles to the wall unless otherwise directed.

C. Install and secure fixtures in place with wall carriers and bolts.

D. Seal fixtures to wall and floor surfaces with non-hardening sealant, color to match fixture.

E. Caulk cast iron flange to soil or waste pipe. Seal joint with beeswax gasket with horn. Do not use putty.

F. Fixture traps, easily removable for servicing and cleaning, shall be installed on every plumbing fixture except those having integral traps. Unless otherwise indicated on the drawings, a combination fixture need have only one trap if one compartment is not more than 6 inches deeper than the other and the waste outlets are not more than 30 inches apart.

G. Type of fixture trap shall be water-seal, self-cleaning "P" trap. Trap water seals shall be not less than 2 inches and not more than 4 inches. Each trap, except integral traps or those that are readily removable, shall have an accessible brass cleanout of ample size, protected by the water seal.

H. The nominal size of each fixture trap shall be same as the fixture drain to which it is connected. The size of the fixture drain for fixtures with integral traps shall not be smaller than the fixture outlet.

I. Exposed pipe connections under pressure shall be iron pipe size seamless tubing, capable of withstanding a working pressure of 100 psi. Each connection to faucet shall be provided with an air chamber of full pipe diameter and not less than 12 inches long.

J. Fixture trim, traps, faucets, escutcheons, and waste pipes that are exposed to view shall be brass with polished chromium plating over nickel finish. Exposed supplies shall be brass pipe plated in the same manner.

K. All faucets shall have metal indices; be of one pattern, design, or compression type with the replaceable seats; and be of the same size as the supply pipes to the fixtures.

L. On each supply line to each fixture provide IPS chrome plated brass nipple through wall with escutcheon plate and angle type loose-key or screwdriver stop. Stops shall have screwed inlets.

M. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons at all piping penetrations through floors, walls, and ceilings.

N. Anchor piping securely in wall or wall space to prevent damage when supply nipples are installed or removed and to prevent vandalism to exposed piping and flush valves.

O. Flush valves shall withstand 100# pull in all directions. Flush valves shall be diaphragm type, with vacuum breaker.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Coordinate faucet locations in epoxy resin counter tops with general work.

3.04 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

A. After plumbing fixtures have been installed, the fixtures and trimmings shall be thoroughly cleaned of all grease, oil, dirt, labels and stickers, and other foreign matter, and all packing materials shall be promptly removed from the premises.

3.06 PROTECTION OF FINISHED WORK

A. All work shall be maintained in clean and proper operating condition until accepted by the Construction Coordinator.

3.07 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as indicated on architectural drawings.

3.08 FIXTURE ROUGH-IN SCHEDULE

	Hot Water	Cold Water	Waste	Vent
Lavatory:	1/2 inch	1/2 inch	1-1/4 inch	1-1/4 inch
Water Closet (Tank Type):		1/2 inch	4 inch	2 inch
Urinal		3/4 inch	2 inch	1-1/4 inch

END OF SECTION 22 40 00

SECTION 23 05 00
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. All applicable requirements of other portions of the Contract Documents apply to the Work of this Section including, but not limited to, all Drawings, all Specifications, General Conditions, and General Requirements including submittals.

1.02 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations to expand the requirements specified in Related Documents.

1.03 RELATED WORK

A. Specified Elsewhere:

1. Section 23 05 29 – Sleeves, Supports, Hangers, Anchors and Seals
2. Section 23 05 48 – Mechanical Sound, Vibration and Seismic Control
3. Section 23 05 93 – Air Systems Testing, Adjusting and Balancing
4. Section 23 07 13 – Duct Insulation
5. Section 23 31 13 – Ductwork
6. Section 23 07 18 – Refrigerant Piping Insulation
7. Section 23 23 00 – Refrigerant Piping and Specialties
8. Section 23 07 13 – Ductwork Insulation
9. Section 23 33 00 – Ductwork Accessories
10. Section 23 34 00 – Power Ventilators
11. Section 23 37 00 – Air Inlets and Outlets
12. Section 23 55 00 – Gas Fired heaters
13. Section 23 62 00 – Air Cooled Condensing Units
14. Section 23 73 01 – Furnaces

1.03 REFERENCE TO STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

B. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Project Representative for a decision before proceeding.

C. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.

1.04 SUBMITTALS

A. General: Submit in accordance with Division 1.

B. Prior to the performance of any work or installation of any materials, obtain approval from the Project Representative by submitting shop drawings and data sheets.

C. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from Subcontractors and material suppliers directly to the Project Representative will not be accepted or processed.

D. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Drawings and data sheets shall show:

1. Principal dimensions and details of construction.
2. Weights of principal parts and total weights with information required for the design of supports and foundations.
3. Sizes and locations of piping and connections.
4. Performance data, including pump and fan curves; fan discharge and inlet noise data; certified by the manufacturer for the equipment furnished.
5. Data on electric motors, including break HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
6. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.
7. Automatic temperature control system including diagrammatic layout of piping, wiring, control device, and equipment, and detailed descriptions of each item of equipment and its function in the system and system operation.
8. Refrigeration for field-assembled systems including description of specialties and pressure drops, layout of piping with lengths, fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.

E. Approval of shop drawings does not release Contractor from responsibility of coordinating his work at job site and taking field measurements. In cases where interferences become apparent, the Contractor shall notify the Project Representative so that such interferences may be resolved prior to proceeding with shop work. No claim will be allowed for work that might have to be moved or replaced based on a claim that work was placed in accordance with dimensions shown on an approved shop drawing.

1.05 RECORD DOCUMENTS

A. Record documents shall be developed in accordance with Division 1.

B. Record Documents: Maintain a clean, undamaged set of Contract Documents and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Documents. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the Project Representative, but was not shown on Contract Drawings or Shop Drawings.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
4. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
5. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
6. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
7. Contract Modifications, actual equipment and materials installed.

C. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.

1.06 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

A. Operating and Maintenance Manuals shall be developed in accordance with Division 1.

B. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Spare parts list.
2. Copies of warranties.

3. Wiring diagrams.
4. Inspection procedures.
5. Shop Drawings and Product Data.
6. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
7. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
9. Servicing instructions and lubrication charts and schedules.

C. All controls and safety devices shall be clearly and permanently marked with embossed or printed plates as to purpose and as to operation and shall be tested in the presence of the Owner's designated representative to insure that he understands their function and purpose.

D. Upon completion of the work, the Contractor shall put the systems into service. The Contractor shall be entirely responsible for the equipment during all testing operations including the turning on and off the apparatus. Each Contractor shall provide the Owner, three 4-hour instruction sessions in the operation of the equipment and systems.

1.07 WARRANTIES

A. Refer to Related Documents for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Division 23, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.08 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project.

B. When two or more items of same material or equipment are required, they shall be by the same manufacturer. Product manufacturer uniformity does not apply as app

licable for project to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

C. Provide products which are compatible within systems and other connected items.

1.09 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location.

1.10 DEFINITIONS

A. The following terms are used throughout the contract documents. The work will be governed in accord with the definitions.

1. The term "Piping" refers to pipe, fittings, valves, flanges, unions, specialties and accessories and appurtenances necessary for, or incidental to, a complete system.
2. The term "Ductwork" refers to all air delivery, recirculation and exhaust ducts whether of sheet metal or other material, and includes all connections accessories and appurtenances necessary for and incidental to a complete system.
3. The term "concealed work" refers to piping and ductwork above ceilings and within walls, partitions, shafts or service spaces, not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would be by removal of finish materials.
4. The term "concealed but accessible work" refers to piping and ductwork accessible above or through suspended ceilings, in walls at access panels or in chases with access doors or mandoors.
5. The term "exposed work" refers to piping or equipment normally exposed to view within rooms or open areas.

PART 2 PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Materials, products, and equipment shall be delivered to job site with factory packaging bearing manufacturer's name or label, and union label whenever practical.

B. Provide for each piece of equipment any special tools required for the operation or adjustment of the equipment and turn over to the Project Representative prior to final approval of the equipment.

C. Exposed machined surfaces of equipment such as shafts, bearing surfaces, gasket surfaces, gears, etc., shall be provided with adequate protection at the factory to prevent physical damage and corrosion prior to installation.

D. Equipment openings and connections shall be provided with adequate covers at the factory to protect the internals, threads, and flanges and prevent entrance of any foreign matter prior to installation.

2.02 MOTORS AND DRIVES

A. Acceptable Manufacturers:

1. General Electric
2. Lincoln
3. Reliance
4. Gould
5. Siemens
6. Louis-Allis
7. Baldor
8. Peerless
9. Century

B. Motors shall be standard NEMA design, of size and characteristics as indicated on the Drawings. Motors shall comply with the specifications set forth in Division 26.

C. Motors shall have the following features:

1. Arranged to operate continuously under full load in an ambient temperature of 40 degrees Centigrade.
2. Motor service factor not less than 1.15, determined by the specific application.
3. Drip-proof unless specific application requires a hermetic, totally enclosed or explosion proof motor as noted.
4. Provided with either internal or external thermal overload protection. Motors to be used with variable frequency controllers shall have internal thermal overload protection.
5. Permanently lubricated or grease reservoir type bearings. Reservoir type bearings shall have top and bottom screw plugs for flushing and repacking.
6. For convenient access (particularly to clear belt guards) the lubrication

fittings shall be extended with pipe and fittings properly secured in place.

7. Windings shall be copper.

D. Drives shall have the following features:

1. Belted motors shall have sliding bases for adjustment of belt tension.
2. Sheaves shall be of the vari-pitch type, except for equipment used with variable speed controllers. Drives and driven sheaves shall be machined cast steel.
3. Belt drives shall be of V-belt type with drive capacity of at least 150 percent of motor horsepower. Belts shall be matched sets when multiple belt drives are used. No fan of integral HP or greater shall have less than two belts.
4. Belt drives, shafts and couplings shall be fully guarded with heavily reinforced expanded metal or woven wire in accordance with OSHA and National Safety Council Standards.
5. Provide openings in the guards all shafts to permit the use of a tachometer.

E. The following Table indicates minimum efficiencies and power factors for three phase motors operating fully loaded at 1800 rpm with electrical characteristics of 200, 230, 460 volts, 60 hertz.

Horsepower		Efficiency	Power Factor
1		82.5	84
1-1/2	84.0	85.7	
2		84.0	85.7
3		85.5	85.0
5		86.5	88.0
7-1/2		88.5	81.0
10		89.5	85.5
15		90.0	84.5
20		91.0	86.0

PART 3 EXECUTION

3.01 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Project Representative.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
14. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

3.02 ELECTRICAL WIRING

A. Contractor furnishing mechanical equipment shall provide all low voltage and line voltage control circuit wiring, conduit and connections and all wiring associated with starter holding coils, unless specifically designated as another Contractor’s work.

B. Electrical Contractor shall be responsible for all line voltage power wiring and final connections to complete the mechanical systems.

C. All wiring shall be in compliance with all State and Local codes and in accordance with specifications set forth in Division 26.

D. The sharing of space within a common conduit by line voltage conductors and by control circuit conductors shall not be permitted.

3.03 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.04 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Related Documents. In addition, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Project Representative, uncover and restore Work to provide for Project Representative observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the

materials and methods required for the surface and building components being patched.

3.05 PERFORMANCE

A. All equipment and systems shall be protected against freezing, flooding, corrosion, and other forms of damage prior to acceptance by the Project Representative.

B. Design and fabrication features or proven methods not specifically covered by this specification shall be specifically stated and documented in the proposal.

C. Labor shall be furnished for assembling all pieces of equipment which, due to shipping limitations, have components which arrive on the jobsite disassembled.

3.06 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Arrange for each installer of equipment that requires regular maintenance to meet with the Project Representative's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Spare parts and materials.
2. Tools.
3. Lubricants.
4. Identification systems.
5. Control sequences.
6. Hazards.
7. Cleaning.
8. Warranties and bonds.
9. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. Provide, to the Project Representative, maintenance information identical to that to be submitted for Maintenance Manuals. These manuals are beyond those required for Maintenance Manuals. Certification of Substantial Completion cannot be made without documentation of startup, including the issue of above noted maintenance information.

3.07 FINAL INSPECTION

A. Prior to final acceptance, all systems shall be operated to test performance to the satisfaction of the Project Representative.

1. Water shall circulate throughout systems without noise, water hammer, leaks, trapping, or air-binding.
2. Air in ducts shall circulate without excessive noise or vibration.
3. Motors, fans, and other equipment shall operate without excessive noise or vibration.
4. Automatic controls shall maintain specified conditions at control points.
5. Systems shall be balanced to operate within the stated tolerances. If any device does not operate within the stated tolerances, then the entire system shall be considered out of balance and shall be readjusted until all units are within the stated tolerances.
6. Equipment and machines shall have initial lubrication, and be aligned and tuned-up for efficient performance.
7. Heating, ventilating, and air-conditioning systems shall maintain uniform temperatures without drafts.
8. Drains shall flow freely, without excessive noise, leaks or stoppages.

B. Defects demonstrated by inspections and tests shall be corrected to the satisfaction of the Project Representative at the Contractor's expense.

3.08 PROTECTION

A. Guards, barricades, lights, services, etc., necessary for the protection of persons and property shall be furnished and maintained.

B. Existing work such as pavements, lawns, sidewalks, floors, curbs, and other structures and utilities which are damaged or disturbed due to making connections or any phase of operations shall be restored to the satisfaction of the Project Representative and the governing authorities.

END OF SECTION 23 05 00

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SECTION 23 05 29
SLEEVES, SUPPORTS, HANGERS, ANCHORS AND SEALS

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. This section covers the requirements to furnish and install sleeves, supports, hangers, anchors and seals for piping and equipment under this contract.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 23 05 00 – Basic Mechanical Materials and Methods
2. Section 23 31 13 – Ductwork.
3. Section 23 34 00 – Power Ventilators.

1.03 REFERENCE TO STANDARDS

A. Standards: Manufacturer's Standardization Society of the Valve and Fittings Industry, M.S.S.:

1. SP 58: Pipe Hangers and Supports - Materials, Design and Manufacture.
2. SP 69: Pipe Hangers and Supports - Selection and Application.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products wrapped in factory-fabricated fiberboard type containers.

B. Do not install damaged products; replace and return damaged units to manufacturer.

C. Store hangers, supports and anchors in clean, dry space. Store in original cartons and protect from dirt, physical damage and construction traffic.

1.06 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Locate all piping, and equipment supports with static and dynamic load on each. Locate all sleeving for mechanical equipment. Locate all flashing for mechanical equipment.

C. Product Data: Provide schedule of sealants with type and location for each.

PART 2 PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

A. Suspension Hangers:

1. Acceptable Manufacturers:

	2-1/2 Inch IPS and Smaller	3 inch IPS and Greater	Copper/Brass Piping, All Sizes
a. Grinnell	Fig. 65	Fig. 260	Fig. CT 65
b. B-Line	Fig. 3104	Fig. 3100	Fig. 3104 CT
c. Persing	Fig. 230	Fig. 200	Fig. 220 CT

2. Adjustable wrought steel clevis type. Copper plated for all hangers in direct contact with copper lines.

B. Adjustable steel yoke pipe roll:

1. Acceptable Manufacturers:

a. Grinnell Fig. 171/181
b. B-Line Fig. B3110/B3114
c. Persing Fig. 322/324

C. Pipe Covering Protection Sleeves for Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 167 Series
b. B-Line Fig. 35L Series
c. Persing Fig. 400 Series

D. Pipe Covering Protection Saddles For Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 160 Series
b. B-Line Fig. 3160 Series
c. Persing Fig. 400 Series

E. Pipe Protection/Thermal Insulation Hanger Shields for Insulated Pipe.

1. Acceptable Manufacturers:

a. B-Line Fig. B3195 Series
b. Insul-shield
c. Pipe Shields
d. Uni-grip

F. Hanger Rods, Galvanized All Thread Rod; ASTM A36:

Hanger rod sizes:

Pipe Size	Hanger Rod Diameter
2 inch and smaller	3/8 inch
2-1/2 inch to 3-1/2 inch	1/2 inch
4 inch to 5 inch	5/8 inch
6 inch	3/4 inch
8 inch	7/8 inch
Over 8 inch	As per Hanger Manufacturer recommendations

G. Wall Brackets:

1. Acceptable Manufacturers:
a. Grinnell Fig. 194/195/196/ Clip Fig. 193

b. B-Line Fig. B3063/B3068/B3067 / Clip Fig. B3063 CP
c. Persing Fig. 153/151/153 / Clip Fig. 153 C

2. Welded steel with capacity as required.

H. Horizontal Pipe Slide Supports:

1. Acceptable Manufacturers:

a. Grinnell 257 Type 3
b. Fluorogold FPS-IT
c. TOBO TPS-100

2. Pipe shall be fixed in place by metal hold down clamps anchored to formed steel channels capped with 1/8 inch Teflon sheet. The Teflon shall be securely fastened to the channel by metal screws or by chemical bond or both.
3. Hold down clamps shall be the "one-piece" type. Hold down clamps shall be sized large enough to allow the pipe to slip in the axial direction thereby allowing for expansion or contraction of the pipe.
4. All metal parts shall be galvanized by the manufacturer and prepared and painted by the plumbing Contractor after assembly. All nuts and bolts shall be cadmium plated.

I. Preformed Metal Framing Channels:

1. Acceptable Manufacturers:

a. Unistrut
b. Superstrut
c. B-Line

2. Continuous slotted steel framing channel in gauge and size for capacities required complete with the matching fittings, nuts, bolts and hangers as shown on the drawings.

J. Auxiliary Steel Angle and/or Pipe:

1. Auxiliary steel angle, channels T-sections for the support of piping or equipment shall be AISI-SAE 1020 low carbon steel or harder. Where piping is used for supports, it shall be Schedule 40 black steel.

2.02 CEILING, WALL AND FLOOR PLATES (Escutcheons)

A. Pipe Penetrations:

1. Hinged snap-on style. 3/4 Inch IPS and Smaller, Chromium plated brass. 1 inch IPS and Larger, Chrome Plated Steel. Sized to fit snugly around uncovered pipe, pipe covering, or sleeve extensions as each location necessitates.

B. Hanger Rod Entrance, Finished Room Ceilings

1. Spring ceiling plates. Chrome plated brass.

2.03 FLOOR AND WALL PENETRATIONS

A. Provide noncombustible seals around pipe and duct penetrations for both new and existing construction at:

1. All Floors
2. Exterior Walls
3. Below-Grade Walls
4. 2-Hour and Greater Fire Rated Walls
5. Smoke Partition Walls
6. Where Designated by Code

B. Fire Rated Caulking Compound

1. Acceptable Manufacturers:

a. Dow Corning - Fire Stop
b. Standard Oil Engineering Materials Co. - Fyre Putty
c. 3M - Fire Barrier

2. Intumescent fire barrier caulk that provide seal against fire, smoke, toxic fumes and moisture.
3. Fire caulk shall provide a fire resistance to match the fire resistance of the wall or floor penetrated.
4. Fire caulk shall be UL listed and meet the testing requirements set forth by ASTM E-814-88.

C. Noncombustible pipe penetrations shall consist of:

1. Pipe sleeves.
2. Fireproof fill in annular space.
3. Surface sealing compound.
4. Provide pipe sleeves for the following:

a. All new construction.
b. Existing construction except where a smooth core drilled hole may be obtained.

5. Pipe Sleeve Material:

    a. Concrete Construction:

        i. Steel pipe sleeve with square welded steel plate extending no less than 6" beyond sleeve, all rustproofed.

    b. All Other Floors and Walls:

        i. 26 Gauge Galvanized Steel Pipe

6. Pipe Sleeve or Core Drill Size:

    a. Diameter great enough to leave 1/2-inch clearance all around and shall be sized to allow pipe insulation to continue uninterrupted through the wall opening.

7. Pipe Sleeve Length:

    a. Length to suit wall or floor thickness.

        i. In walls, ends flush with each wall face.
        ii. Underside of floors, extend downward approximately 1 inch below bottom of floor surface.
        iii. Above floors, extend upward approximately 3 inch above finished floor surface.

8. Annular Space Filler For Pipes:

    a. Acceptable Manufacturers:

        i. Cheme Ind. - Gripper 1" - 8"
        ii. Thunderline - Link Seal
        iii. Instafoam - Front Pak

    b. Below-Grade Exterior Walls

        i. Mechanical seals consisting of synthetic rubber links with plated steel bolts and Delrin pressure plates that provide hydrostatic sealing.

    c. All Other Walls and Floors

        i. Fire rated caulking compound designed expressly for this purpose.

ii. Mechanical seals described above.

D. Noncombustible Duct Penetrations Consist Of:

1. 3" high (maximum), 24 gauge galvanized duct collar both sides of the floor or wall.
2. Annular Space Filler For Ducts.

a. Fire rated caulking compound designed expressly for this purpose.

E. All Other Duct and Wall Pipe Penetrations

1. Pipe Penetrations consist of:

a. Finished and unfinished space: Pipe sleeve as described in noncombustible pipe penetrations.
b. 1/2" annular space between pipe and wall.

2. Duct penetrations consist of:

a. Finished and unfinished spaces 3" high (maximum) 24 gauge.
b. 1/2" annular space between duct and wall.

2.04 SEALS, SAFING AND FLASHING

A. Wall and Floor Seals: Wall and floor seals shall be modular mechanical type with interlocking synthetic rubber links. Manufacturers/Models:

1.	Thunderline	No. 300, 400, 500 "Link-Seal"
2.	Clow	No. F-1430, F-1435
3.	Tyler	Nos. F-796, F-797

B. Roof Flashing:

1. Where plumbing vent penetrates roof and flashings must be attached to pipe, the flashing shall be 24 gauge galvanized metal.

C. Sealant:

1. Acceptable Manufacturers:

a.	General Electric	Silicone Construction 1200
b.	DAP	One Part Acrylic Sealant
c.	Dow Corning	Silicone Rubber Sealant

2. Caulking for exterior flashing shall be silicone or butyl rubber.

3. Caulking shall be capable of weathering in temperature ranging from -30 degrees F to 180 degrees F and in direct sunlight maintaining its elasticity and its adherence to the material on which it was applied.
4. Caulking color shall be black or where visible shall be chosen by the Construction Coordinator.

2.05 LOW VELOCITY DUCT HANGERS AND SUPPORTS

A. All horizontal ducts up to 48" wide shall be supported with strap iron hangers placed down side of duct, turned under bottom of ducts and fastened to ductwork. Straps shall be fastened to building construction by approved methods specified.

B. All horizontal ducts over 48" wide shall have angle iron trapeze hangers with rods attached to building construction by approved methods specified.

C. Rectangular Duct Hanger Sizes:

Width	Strap	Spacing
Up 10 18"	1" x 22 ga.	8 ft.
19" thru 24"	1" x 20 ga.	8 ft.
25" thru 30"	1" x 18 ga.	8 ft.
51" thru 60"	1" x 16 ga.	8 ft.

D. Round Duct Hanger Sizes:

Diameter	Strap Band	Rod	Spacing
Up to 26"	1" x 20 ga.	1/4"	10 ft.
27" thru 36"	1" x 18 ga.	3/8"	10 ft.
37" thru 50"	1" x 16 ga.	3/8"	10 ft.
51" thru 60"	1" x 18 ga.	3/8"	6 ft.

E. Trapeze Hanger Angles:

Width	Angles	Rods	Spacing
48" thru 60"	1-1/2" x 1-1/2" x 1/4"	3/8"	8'-0"
61" thru 72"	1-1/2" x 1-1/2" x 1/4"	3/8"	6'-0"
73" thru 96"	2" x 2" x 1/4"	1/2"	6'-0"

F. Vertical Duct Floor Support Sizes:

1. Supports shall be riveted or screwed to duct.
2. Up to 60" wide, 1-1/2" x 1/8" angle.
3. Over 60" wide, 2" x 2" x 3/16" angle.

PART 3 EXECUTION

3.01 HANGERS AND SUPPORTS

A. Hangers in General:

1. All piping shall be supported as specified herein. All structural steel, hanger rods, turnbuckles, beam clamps, angle iron clips, inserts, brackets, floor bases, supports and bracing shall be provided.
2. Provide supports, where pipe changes direction, adjacent to flanged valves, strainers, and fittings and at equipment.
3. Horizontal suspended piping shall be supported with adjustable hanger assemblies. Provide the specified clevis type with weight bearing insulation and protection shield. All hanger rods shall have enough length and threaded length to allow adjustment.
4. Vertical pipe runs shall be supported and laterally braced at every floor level. Support vertical pipe with riser clamps installed below hubs, couplings or lugs, welded to the pipe.
5. Piping shall be supported as follows:

	Maximum Spacing	
Pipe Sizes	Ferrous Pipe	Copper Tubing
2 inch - 1 inch	6 feet	5 feet
1-1/4 inch - 2 inch	8 feet	8 feet
2-1/2 inch - 3 inch	12 feet	8 feet
4 inch - 6 inch	14 feet	8 feet
8 inch - 14 inch	20 feet	---
Over 14 inch	As per Pipe Manufacturers Recommendations	

6. Piping shall be properly supported from hangers securely attached to the building construction using clamps for steel construction, anchors for concrete construction or lag screws or bolts for wood construction or as otherwise detailed on drawings or specified.
7. All piping shall be supported in a manner to minimize undesirable stress on bodies of valves and other fittings.
8. All piping shall be supported from walls on brackets, directly from the floor above, or from auxiliary steel. Do not support pipe from ceilings.
9. No cutting, drilling, welding or burning on any structural steel member shall be allowed. Power driven studs and welding studs shall not be allowed.
10. All bolts and threaded rods shall be used with double nut and washer or single nut, washer, and lock washer wherever a single unsecured nut could work loose and allow either threaded rod or supported piping to drop.
11. Cast in place concrete anchors shall be positioned and secured to reinforcing.

12. All Pipe hangers shall be cleaned and painted with rust resistant paint before installation.

3.02 PIPE MOVEMENT

A. Design and install hangers to resist disengagement from movement of supported pipe.

B. Provide allowances for expansion and contraction of installed piping. Install piping in a manner that will not cause more than negligible stress nor cause leaks due to thermal expansion and contraction. Movement of pipe shall not result in noise generation.

3.03 EQUIPMENT BASES

A. Provide for all floor mounted equipment reinforced concrete housekeeping bases poured directly on structural floor slab 4" thick minimum, extended 6" minimum beyond machinery bedplates. All edges of the pad shall be chamfered. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. Contractor shall provide these concrete bases, coordinate with Contractor.

B. Concrete supplied for machine base and pad shall have a minimum compressive strength of 3,000 psi and be reinforced with 6 x 6 - W2.1 x W2.1 WWF.

C. Pads shall be doweled into slab floors with one 2 inch dowel rod per 6 square feet of pad, but not less than 4 dowels. Dowel shall project a minimum of 2 inches into the slab and 2 inches into the pad.

3.04 SUPPORT OF UNDERGROUND PIPING

A. Where fill or loose soil of shallow depth is encountered, over-excavate down to firm undisturbed earth and backfill to the proper elevation with bank sand or crushed stone compacted to provide a firm support for the pipelines.

B. Where deep fill or large areas of unstable soil is encountered, support the pipe at least every 10 feet - 0 inch (at each hub of cast iron soil pipe and cast-iron water pipe) on concrete piers or concrete blocks with footings set on undisturbed earth, and fill the area between the piers with firmly compacted granular material.

C. At the foot of each plumbing riser, provide a concrete foundation with base set on solid earth for support of the stack.

D. Set all equipment bases, basins, and similar structures on solid undisturbed earth and provide substantial bases.

E. Where loose fill or unstable soil is encountered, provide concrete foundations, properly reinforced and carried down to firm bearing with footings set on undisturbed earth.

F. Design and construction of all bases and foundations must be reviewed by the Construction Coordinator.

3.05 CUTTING, DRILLING AND PATCHING

A. Contractor shall do all cutting and drilling that is required in order that its work may be properly installed and it shall do all patching and repairing required to restore all surfaces to their original condition.

B. Where holes are required, these shall be cut in a careful manner and the openings kept to an absolute minimum.

C. The cutting and drilling into structural members or slabs may be accomplished only upon the prior written concurrence of the Construction Coordinator.

D. Openings in a slab on grade shall be made by scoring with a concrete saw followed by a chiseled clean break. Such floor openings shall be restored using fully compacted granular subgrade and concrete bonded to the vertical pipe installed through the floor. No sleeve is to be placed in such case, and concrete shall be sloped upward around the pipe to prevent water ponding at that point.

E. All patching and repairing shall be done by experienced men in the particular trades to which the respective kinds of work belong; and shall be neatly made, restoring the area to its original condition to the satisfaction of the Construction Coordinator.

3.06 PRIMING

A. Prime coat exposed steel hangers and supports.

3.07 SLEEVES, SEALS, SAFING, FLASHING AND SEALANT

A. Wall and Floor Seals and Sleeves:

1. Setting:

a. Set sleeves in position in advance of concrete work.
b. Provide suitable reinforcing around sleeves.

2. Sleeves shall be cut the same length as the thickness of the walls and 1-1/2" longer than thickness of floors. 1-1/2" shall extend above the floor.
3. Cuts should be square or round and ground smooth.
4. In outside walls and in floors the annular space between the pipe and the

sleeves shall be sealed with a flexible link seal as per this Specification.

5. In interior walls the annular space between the pipe and the sleeve shall be sealed tight with oakum.
6. Sleeves shall be sized with 2" of open space between outside pipe and inside of sleeve unless otherwise specified in individual sections.
7. Cuts between sleeves and walls or floors shall be patched with mortar to the approval of the Construction Coordinator.

B. Flashing:

1. Flashing for vent piping shall be soldered or lapped over vent piping and feather out on top of roof. Flashing should be sealed to roof with roofing pitch.
2. Wherever curbs or chimneys penetrate sloped roofs such that the joint formed by the curb or chimney and the roof is a straight line parallel to the ridge of the roof a cricket flashing shall be installed. Thus flashing shall be sloped towards the sides of the curb or chimney at a minimum of 4/12 pitch such that no water may collect above the chimney or curb on the roof surface.
3. Flashing shall extend at least 8" underneath lapping roofing. On sloped roofs the lower flashing shall extend 8" over the top of the roofing and be secured with nails into wood, screws into sheet metal and anchors into concrete.
4. Nails, screws, anchor, and exposed flashing edges shall be covered and sealed with sealant as listed in this Specification.
5. Flashing attached to sheet metal shall be riveted into place with beads of sealant applied between the two metal surfaces and along the exposed edges.
6. All fasteners shall be of the same material as the flashing.
7. Caulking sealant shall not be used to fill gaps in flashing greater than 1/4". Gaps of this size shall be covered by flashing material, fastened and sealed into place.
8. Flashing, sealant and fasteners shall be painted a uniform color as per Construction Coordinator.

3.08 DUCT HANGERS AND SUPPORTS

A. Furnish and install hangers and supports to carry the weight of ductwork, including dampers without incurring vibration, sagging, bending, twisting, buckling, or other deformation in the ductwork or the building structure either during erection, testing, or normal operation. Include as part of the ductwork support systems all necessary auxiliary structural members required to provide support locations where building elements do not occur or are inadequate for attaching loads and as indicated on the Drawings.

B. Each duct shall be hung or supported independently directly to building structure or

auxiliary steel without attachments to other supported elements such as piping, conduit, ceilings, equipment or other duct.

C. All horizontal ducts shall be supported with substantial angle and strap trapeze hangers, placed entirely around side and bottom of ducts and securely fastened to the building construction. Angles and straps used to support ducts shall be galvanized. Provide hanger near each circumferential joint.

D. Vertical Ductwork: Unless otherwise indicated support vertical round and rectangular ductwork every 15' or at each floor in building. Unless indicated otherwise by details on Drawings, vertical ductwork shall be supported as specified herein.

3.09 ADJUSTING AND CLEANING

A. Adjust hangers and supports and place grout as required under supports to bring piping and equipment to proper levels and elevations.

END OF SECTION 23 05 29

SECTION 23 05 48
MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes noise limits and vibration isolation for all equipment, piping, and ductwork.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 34 00 – Power Ventilators.
2. Section 23 74 00 – Air Handling Units.

1.03 REFERENCE TO STANDARDS

A. ASHRAE.
B. BOCA
C. OSHPD in the State of California
D. State and local codes.

1.04 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop drawings shall include:

1. Outside diameter free, operating, and solid heights of springs.
2. Angular hanger rod misalignment capability.
3. Design of supplementary and inertia bases.
4. Pressure and temperature ratings, minimum burst pressure and allowable movement capability of flexible connectors.
5. Free and operating heights and size of neoprene pads.
6. Corrosion protection and weather seal details.

1.05 ACCEPTABLE NOISE LEVELS

A. Noise levels are specified for two distinct areas. The first area is for occupied rooms which will use the RC curves from ASHRAE 1997 Fundamentals book for acceptable noise levels. The second area is for mechanical rooms which will use the dBA rated scale.

B. Occupied Rooms - Systems shall be designed for an RC-35 noise level. This level

will enable normal office conversation to be intelligible. Octave bands are summarized below. These values are maximums and should not be exceeded.

re. 0.0002 Microbar dB	60	55	50	45	40	35	30	25
Octave Band Center Hz	31.5	63	125	250	500	1000	2000	4000

C. Mechanical Rooms - Systems shall be designed for an NC 70 noise level. This level will enable workers to be present on an 8-hour shift. Octave bands are summarized below. These values are maximums and should not be exceeded.

re. 0.0002 Microbar dB	X	93	79	75	72	71	69	68
Octave Band Center Hz	31.5	63	125	250	500	1000	2000	4000

D. In the event that noise levels are surpassed in either the Occupied Rooms or Mechanical Rooms, noise suppression techniques shall be required, and shall be the responsibility of the Contractor who installs the offending system. The Contractor shall insure that his system is provided with sound attenuation devices to assure compliance with the above maximum acceptable noise limits.

1.06 QUALITY ASSURANCE

A. All isolation materials used by each Contractor shall be supplied by one manufacturer.

B. The manufacturer and his authorized representative shall be responsible for and provide written certification for:

1. Proper Size
2. Type
3. Selection

C. Vibration isolator shall be selected in accordance with weight distribution of the isolated equipment to provide a reasonably uniform deflection.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION DEVICES

A. Vibration isolation devices and materials shall be of the types indicated on schedules and from the following Vibration Isolation Types paragraph. The vibration isolation types establish the minimum criteria to be used in determining the proper type and size of isolators for all equipment requiring them.

2.02 VIBRATION ISOLATION TYPES

A. Type A: Precompressed 5/16" thick molded neoprene isolation pads with the following features:

1. Acceptable Manufacturers:

a.	Korfund	Korpad
b.	Mason Industries	W
c.	Vibration Mountings	Shear-Flex
d.	Kinetics	N
e.	Vibration Eliminator	200 N

2. Neoprene jacketed and stabilized during manufacture
3. Sized for 40 to 60 pounds per square inch cover.
4. Static deflection as required.
5. Steel plates bonded to top of pads where required to spread the equipment load.

B. Type B: Vibration hanger with steel spring and 0.3 inch deflection neoprene or fiberglass element in a series with the following features:

1. Acceptable Manufacturers:

a.	Korfund	30VX
b.	Mason Industries	30N
c.	Vibration Mountings	RSH-30A
d	Kinetics	SFH or SRH
e.	Vibration Eliminator	SNRC

2. Encased in welded hanger bracket.
3. Hanger rod isolation bushing.
4. Minimum 50 percent additional travel between design operating height and solid height.
5. 30 degree angular hanger rod misalignment capability.

PART 3 EXECUTION

3.01 INSTALLATION

A. All vibration isolators shall be installed in strict accordance with the isolation manufacturer's recommendations.

B. Bolt isolator to equipment and to supporting structure where bolt holes are supplied.

C. Shim or adjust leveling screws to level equipment. Shims shall not interfere with spring action.

D. Verify actual deflected height with design operating height. Replace when they differ by 25 percent or more.

E. Correct interferences with spring action or report to Construction Coordinator when interference is caused by another Contractor.

3.02 CORROSION PROTECTION

A. All vibration isolators exposed to weather (or a corrosive atmosphere when designated) shall have:

1. Steel parts hot dip galvanized.
2. Bolts cadmium plated.
3. Springs hot dip galvanized or neoprene coated.

B. All vibration isolation for interior use shall have the manufacturer's standard paint finish on mountings and springs.

END OF SECTION 23 05 48

SECTION 23 05 93
AIR SYSTEMS TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The extent of work as required by the drawings and these specifications. This work includes testing, adjusting and balancing of all air handling equipment and systems including exhaust fans and accessories.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 74 00 –Air Handling Units.
2. Section 23 34 00 – Power Ventilators.
3. Section 23 37 00 – Air Inlets and Outlets.

1.03 REFERENCE TO STANDARDS

A. SMACNA
B. NEBB
C. AABC
D. TABIC

1.04 QUALITY ASSURANCE

A. Only qualified personnel shall perform testing and balancing work.

B. Submit evidence that the personnel who will perform the testing and balancing of the project systems are qualified personnel for review and approval by the Construction Coordinator prior to performing the work.

C. Submit a list of completed projects successfully tested and balanced by the submitted qualified personnel for review and approval, by the Construction Coordinator, prior to performing the work.

D. When the Contractor does not have qualified personnel on his staff he shall employ them from other firms or subcontract the work to a test and balance firm normally engaged in this type of work.

E. Perform all corrective measures caused by faulty installation at Contractor's own expense. Retest, readjust and rebalance systems until satisfactory results are achieved.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B Submit Data Sheet on each item of testing equipment for Construction Coordinator approval. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

C. Submit a report containing all test data and other related information recorded during testing and balancing, placed on appropriate forms for Construction Coordinator review and approval. Reports shall certify that the methods used and results achieved are as specified.

1.06 QUALIFICATIONS

A. Qualified personnel are:

1. Personnel who have been certified by one of the following organizations.

a. AABC - Associated Air Balance Council.
b. Certified TBAB - Certified Testing, Balancing and Adjusting Bureau.
c. NEBB - National Environmental Balancing Bureau, Illinois Chapter.
d. SMARTA - Sheet Metal, Air Conditioning & Roofing Contractors Trade Association of Illinois.
e. TABIC - Test and Balancing Institute for Certification.

2. Personnel with a general engineering or mechanical engineering degree from an accredited four-year college.

PART 2 PRODUCTS

2.01 AIR BALANCE INSTRUMENTS

A. Velometer with probes and Pitot tube.

B. Rotating vane anemometer.

C. ASHRAE Standard pitot tubes, stainless steel 3/16 outside diameter, lengths 18" and 36".

D. Magnehelic differential air pressure gages, 0 to 0.5", 0 to 1.0" and 0 to 5.0" water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.

E. Combination inclined-vertical portable manometer, range 0 to 5.0" water.

F. Portable type hook gage, range 0 to 12" water.

G. Portable flexible U-tube manometer, magnetic mounting clips, range 0 to 18" water.

H. Static pressure probe for induction unit.

I. Conical or pyramidal shaped hood.

2.02 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Insertion thermometers, with graduations of 0.5 deg. F.

B. Sling psychrometer.

C. Tachometer, centrifugal type.

D. Revolution counter.

E. Clamp-On Volt-ammeter.

F. Portable recorders for temperature and humidity.

PART 3 EXECUTION

3.01 AIR SYSTEMS

A. Test, adjust and balance systems in accord with the following:

1. Preliminary:

a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals. Inspect all system components for proper installation and operation.
b. Use manufacturer's ratings for all equipment to make calculations except where field test shows ratings to be impractical.
c. Verify that all instruments are accurately calibrated and maintained.
d. Install clean filters.

2. Central System:

a. Test adjust and record exhaust fan RPM to design requirements within the limits of mechanical equipment provided.
b. Test and record motor voltage and running amperes including motor nameplate data and starter heater ratings.
c. Test and record system static pressure, suction and discharge.
d. Test and adjust system for design outside air, cfm.

e. Test and record heating apparatus entering air temperatures, dry bulb.

3. Verification:

a. Prepare summation of readings of observed cfm for each system, compare with specified cfm and verify that duct losses are within specified allowable range.
b. Verify design cfm at fans.

3.02 CONTROL SYSTEM

A. The HVAC Contractor shall set and adjust automatically operated devices to achieve sequence of operations.

B. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment.

3.03 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, make temporary installation of portable recorders and simultaneously record temperatures summer and winter conditions at representative locations in each system inside of building.

B. Construction Coordinator will direct test locations.

C. Make recordings during summer and winter for a seven-day period, continuous over a weekend and including at least one period of operation at outside conditions within 5 degrees F wet bulb temperature of 75 deg. F for maximum summer design condition and within 10 degrees F dry bulb temperature of minus 3 deg. F for minimum winter design conditions.

D. Report of test results shall include original recording and two reproductions.

3.04 REPORT SUBMITTAL

A. Fill in test results on appropriate forms.

B. Submit three certified copies of test reports to the Construction Coordinator for approval.

C. Include in report a list of instruments used and last date of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13
DUCT INSULATION

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes all duct insulation and accessories.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 31 13 – Ductwork.

1.03 REFERENCE TO STANDARDS

A. ASTM C553 - Standard Specifications for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. NFPA 225 - Test of Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Submit shop drawings which indicate complete material data, list of materials proposed for this project and indicate K-value, and thickness of material for individual services.

C. Product Data: Provide manufacturers data sheets for:

1. Insulation
2. Adhesives
3. Coatings
4. Sealants
5. Tape

1.06 REGULATORY REQUIREMENTS

A. National Fire Protection Association, NFPA: NFPA 255 - Test Methods Surface Burning - Building Materials.

1. Flame Spread: 25 or less.
2. Smoke Developed: 50 or less.
3. Fuel Contributed: 50 or less.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer’s density and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic.

C. Protect insulation against dirt, water, chemical, and mechanical damage.

D. Do not install damaged insulation; remove from project site.

1.08 PROJECT CONDITIONS

A. Perform work at ambient and equipment temperatures as recommended by adhesive manufacturer.

PART 2 PRODUCTS

2.01 DUCT INSULATION

A. Foil Faced Fiberglass Duct Blanket Insulation Type I-1.

1. Acceptable Manufacturers:

a.	Manville	J-M Microlite FSK-1
b.	Owens-Corning	Faced Duct Wrap FRL 25
c.	Certan Teed	Duct Wrap - Type IV
d.	Knauf	Duct Wrap - FSK

2. Flexible fiberglass blanket conforming to ASTM C553, Type 1, with vapor barrier (Reinforced Foil Kraft).
3. Thermal conductivity k - .24 at 75 degrees F.
4. Density shall be 1.5 pound per cubic foot.
5. Thickness, as scheduled.
6. Insulaton shall be UL labeled for flame spread and smoke developed

2.02 INSULATION ACCESSORIES - ACCEPTABLE MANUFACTURERS & PRODUCTS

A. Adhesive

3M Mfg. Co.	1357 Contact Cement
Goodloc E. Moore	Tuff Bond
Chicago Mastic	17-461

B. Adhesive Foamed Plastic:

Manville	J-M 57
Armstrong Cork	520
Rubatex	373

C. Adhesive (Vapor Barrier Lap):

Chicago Mastic	17-456
Childers Products	CP-80
Armstrong Cork	520

D. Coating (Vapor Barrier):

Chicago Mastic	17-145
Childers Products	CP-32
Foster/Amchem	Tite-fit 30-35

E. Sealant (Waterproof):

3M Mfg. Co.	612 Scotch-Seal
Childers Products	CP-70

F. Tape (Vapor Barrier):

3M Mfg. Co.	340
Childers Products	Fastape 0802

PART 3 EXECUTION

3.01 INSTALLATION - THERMAL INSULATION

A. Each Contractor shall be responsible for the insulation of all ducts equipment, etc., hereinafter specified and/or noted on the Drawings.

B. All insulation shall be continuous through sleeves, wall and ceiling openings, and wall studs.

C. All equipment and other finished surfaces around work areas shall be adequately covered and protected against damage and soilage during installation of insulation material.

D. All existing insulation damaged and/or removed by the Contractor shall be repaired or replaced with new insulation as directed by the Construction Coordinator's representative.

E. No insulation or covering shall be installed until equipment have been tested and approved.

3.02 DUCT INSULATION

A. Faced Fiberglass Insulation Blanket Type: Type I-1

1. All interior supply and return air ducts located in concealed areas shall be insulated with covering exterior to duct.
2. Duct insulation thickness shall be equal to the duct reinforcement but not less than 1" thick. Insulation shall be fastened to ductwork with mechanical fasteners at a maximum of 12" on centers and a maximum of 3 inches to the corner or edge.
3. Ductwork shall be covered by adhering insulation with flexible blanket adhesive. Adhesive shall be applied in 6" strips on a minimum of 12" centers. Tightly butt the insulation and lap vapor barrier jacket minimum 2" at all joints. Secure laps with vapor barrier to lap adhesive. Ducts with a width over 30" shall be further secured on the underside with mechanical fasteners on 18" centers.
4. Insulation shall be applied over clean, dry surfaces.
5. Hangers, supports, anchors, that are secured directly to the duct shall be adequately insulated and vapor sealed to prevent condensation.
6. Seal all terminating edges of insulation by lapping vapor barrier jacket to duct securing with vapor barrier adhesive. Further wrap full circumference with vapor barrier tape set in vapor barrier lap adhesive.

7. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation.
8. If hangers are installed adjacent to the duct, such hangers shall be completely insulated and the hanger rods or straps shall be insulated at least 8" up with the open end sealed vapor-tight. Rigid insulation inserts (J-M, T-12 or equal) shall be installed as required under outside hangers. Inserts shall be of equal thickness to the adjoining insulation and shall be provided with vapor barrier seals where required.
9. Specified adhesives, mastics and coatings shall be applied at the manufacturers recommended minimum coverage per gallon.
10. All joints, raw edges, staples, and mechanical fastener clips shall be sealed with pressure-sensitive tape.

3.03 INSULATION SCHEDULE

SERVICE	OPERATING TEMPERATURE	DUCT SIZE	INSULATION TYPE	THICKNESS
Supply and Return Ductwork	-20°F to 110°F	All	I-1	1"
Exhaust/Relief Ductwork	Not To Be Insulated			

END OF SECTION 23 07 13

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SECTION 23 07 18
REFRIGERANT PIPING INSULATION

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes insulation of all refrigerant piping.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 01 51 85 – Refrigerant Piping and Specialties.
2. Section 01 57 20 – Air Handling Units.
3. Section 01 57 33 – Air Cooled Condensing Units
4. Section 01 57 35 – Ductless Split-Type Air Conditioners.

1.03 REFERENCE TO STANDARDS

A. ASTM C916.
B. ASTM C534-88.
C. ASTM C578-87a.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, etc.

C. Product Data: Provide manufacturers data sheets for:

1. Pipe insulation.
2. Insulation jackets.
3. Fitting jacket.
4. Adhesive.

PART 2 PRODUCTS

2.01 PIPE INSULATION

A. Pipe Insulation: Type P-2

1. Acceptable Manufacturers:

a. Armstrong - "Armaflex".
b. B.F. Goodrich - "Flexible Insulation Tubing and Sheeting".
c. Manville Corp. - "Aerotube"

2. Closed cell, flexible foamed plastic conforming to ASTM C534, "Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
3. Conductivity (k) equals approximately 0.27 BTU/HR.,SF., EF per inch thickness at 75 degrees F.

PART 3 EXECUTION

3.01 INSULATION INSTALLATION

A. Preparation:

1. Do not apply insulation until piping has been leak tested.
2. All surfaces to be insulated shall be dry and free of loose scale, rust, dirt, oil

or water.

B. Application:

1. Insulation shall be installed in a smooth, clean workmanlike manner. Joints shall be tight and finished smooth without fishmouths.
2. Insulation shall fit tightly against the surface to which it is applied to prevent air circulation between the insulation and the pipe or equipment to which it is applied.
3. Insulation applied to cold piping or equipment shall be completely vapor sealed, free of pin holes or other openings.
4. Do not use wet insulation materials.
5. All longitudinal joints on vertical pipe runs shall be staggered.
6. Apply insulation to permit expansion or contraction of pipe lines without causing damage to insulation or surface finish.
7. Do not apply mastic or adhesive until all previous applications of mastic and adhesives have thoroughly dried.
8. No bands or staples shall be provided on covering.
9. Provide 24 gauge sheet metal saddle between the pipe hanger/support and the exterior of the insulation. Saddle length shall be the same as insulation inserts.

C. Application at Fittings:

1. Insulation of flanges and flanged fittings shall overlap adjacent pipe covering at least 1 inch. Valves shall be insulated up to the gland only.
2. Pipe line strainers shall be insulated in a manner to permit removal of strainer basket without disturbing insulation of the strainer body.
3. Insulation adjacent to uninsulated flanges shall be tapered back and neatly finished to allow access to and removal of bolts without injury to covering.

D. Insulation shall be slipped on the pipe prior to connection, and the butt joints shall be sealed. Where the slip-on technique is not possible, the insulation shall be carefully slit and applied to the pipe.

E. Apply sheet insulation to fit as closely as possible to equipment. Support insulation as required.

F. All joints shall be sealed with the manufacturer's recommended adhesive.

G. Do not apply insulation in multiple layers.

H. Do not use Type P-2 insulation in plenums or fire wall penetrations. Use Type P-1 insulation through sleeve and vapor seal the joint between the two insulations. See specification section 15084 for material and installation data of type D-1 insulation.

I. Insulation shall be painted with insulation manufacturer's recommended ultra-violet light protection paint. Apply a minimum of two coats of paint.

3.03 FLEXIBLE FOAM INSULATION SCHEDULE

A. Type P-2 insulation shall be applied to all refrigerant suction lines and valves; 1/2 inches thick.

END OF SECTION 23 07 18

SECTION 23 23 00
REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section covers the requirements for all refrigerant piping systems.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 07 18 - Refrigerant Piping Insulation.

1.03 REFERENCE TO STANDARDS

A. ANSI B31.5
B. ASHRAE 15 - 1989 Safety Code for Mechanical Refrigeration

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, etc.

C. Product Data: Provide manufacturers data sheets for:

1. Pipe.
2. Fittings.
3. Special refrigerant valves.
4. Refrigerant specialties.

PART 2 PRODUCTS

2.01 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials use in refrigerant piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.02 PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings in accordance with the following listing:

1. Tube Size 3" and Smaller: Copper tube, Type L, ASTM B88 refrigerant grade, hard-drawn temper; wrought-copper, solder-joint fittings; soldered joints.
2. Soldered Joints: Solder joints using silver-lead solder, ASTM B 32, Grade 96 TS.
3. Ends shall be plastic capped.

B. Pre-charged re-insulated copper refrigerant pipe may be used.

2.03 REFRIGERANT VALVES

A. General: Special valves required for refrigerant piping include the following types:

1. Globe and Check Valves:

a. Acceptable Manufacturers:

i. Henry Valve Co.
ii. Parker Hannifin Corp.; Refrigeration & Air-Cond. Div.
iii. Sporland Valve Co.

b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 degrees F. (49 degrees C) temperature rating, 500 psi working pressure.

c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 degrees F. (121 degrees C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

a. Acceptable Manufacturers:

i. Alco Controls Div.; Emerson Electric Co.
ii. Automatic Switch Co.
iii. Sporland Valve Co.

b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, UL-listed, 1/2" conduit adapter, 250 degrees F. (121 degrees C) temperature rating, 400 psi working pressure.

c. Manual Operator: Provide manual operator to open valve.

2.04 REFRIGERANT SPECIALTIES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

1. Alco Controls Div.: Emerson Electric Co.
2. Henry Valve Co.
3. Parker-Hannifin Corp.; Refrigeration and Air-Conditioning Div.
4. Sporlan Valve Co.

B. Refrigerant Strainers: Brass shell end connections, brazed joints, monel screen, 100 mesh, UL-listed, 350 psi working pressure.

C. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 degrees F. (93 degrees C) temperature rating, 500 psi working pressure.

C. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring,

wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF REFRIGERANT PIPING

A. General: Install refrigerant piping in accordance with equipment manufacturer's recommendation.

B. Install refrigerant piping with 1/4" per foot (1%) downward slope in direction of oil return to compressor.

C. Provide oil traps and double risers where indicated, and where required to provide oil return.

D. Clean refrigerant piping by swabbing with dry lint less (linen) cloth, followed by refrigerant oil soaked swab.

E. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

F. Flux, solder and scale shall be thoroughly cleaned from the tube. Tubing shall be filled with nitrogen while soldering to prevent oxidation. Bleed dry nitrogen through refrigerant piping during brazing operations.

7. All tubing shall remain capped until assembled.

8. All equipment shall be maintained absolutely dry and clean during handling and assembly.

9. The system shall be completely leak tested with a halide torch or approved refrigerant leak tester.

3.03 INSTALLATION OF REFRIGERANT VALVES

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions. Remove accessible internal parts before soldering, replace after joints are completed.

1. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.

B. Charging valves, expansion valves, solenoid valves, back seating type service valves, and any other valves necessary for the safe and proper operation of the refrigerating system shall be included in the installation.

C. Seal caps shall be used on all refrigerant valves.

3.04 INSTALLATION OF REFRIGERANT ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines and in accessible location for service.

B. Moisture-Liquid Indicators: Install on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter-Dryers: Install in refrigerant lines and in accessible location for service.

3.05 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.06 FIELD QUALITY CONTROL

A. Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5, "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using halide torch. System must be entirely leak-free.

B. Repair or replace refrigerant piping as required to eliminate leaks and retest as specified to demonstrate compliance.

3.07 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with vacuum pump, until temperature of 35 degrees F. (2 degrees C) is indicated on vacuum dehydration indicator.

C. During evacuation, apply heat to pockets, elbows, and low spots in piping.

D. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

E. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.

F. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

3.08 ADJUSTING AND CLEANING

A. Cleaning and Inspecting: Clean and inspect refrigerant piping system.

END OF SECTION 23 23 00

SECTION 23 31 13
DUCTWORK

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes fabricated ductwork.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 33 00 – Ductwork Accessories.
2. Section 23 37 00 – Air Inlets and Outlets.

1.03 REFERENCE TO STANDARDS

A. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, First Edition" for fabrication and installation of low pressure.

B. ASHRAE Standards: Comply with ASHRAE handbook and Product Directory, 1988 Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of low pressure ductwork.

C. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

D. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards - First Edition".

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate layout of ductwork and equipment, including coordination dimensions and clearances.

C. Product Data: Provide manufacturers data sheets for the following items:

1. Duct Sealant.
2. Duct Cement.
3. Duct Liner.

PART 2 PRODUCTS

2.01 DUCTWORK

A. Ductwork Materials

1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A90, ANSI/ASTM A 525 and A527, lockforming quality.

a. Coating: G90 zinc coating (1.25 oz./S.F.).

2. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view, provide materials, which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, strains and discolorations, and other imperfections, including those that would impair painting.

B. Miscellaneous Ductwork Materials

1. General: Provide miscellaneous materials and products of types and sizes

indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

2. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
3. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
4. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
5. Duct Liner: Fibrous glass complying with ASTM C 1070, Type I, ASHRAE 62-89, NFPA 90A and 90B.

    a. Thickness: 1 inch.
    b. R-Value: 8.0
    c. Sound Absorption Coefficient (NRC): .70
    d. Constructed to operate under duct velocities up to 5000 fpm.
    e. Surface coatings shall not support microbial growth including fungus and bacteria.

6. Duct Liner Adhesive: Comply with Adhesive and Sealant Council, Inc. (ASC) ASC-A-7001.
7. Duct Liner Fasteners: Comply with SMACNA MF-1.

C. Fabrication

1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assembly work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.
2. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards - First Edition", for 1" W.G., positive or negative.
3. Shop fabricate ductwork of gages and reinforcement complying with ASHRAE Handbook and Product Directory, 1988 Equipment Volume, Chapter 1 "Duct Construction", for 2" W.G., positive or negative.
4. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20

degrees for expanding tapers.

5. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Section 23 33 00 "Duct Accessories" for accessory requirements.

6. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
7. The weight of steel shall be less as described in the SMACNA Manual "HVAC Duct Construction Standards", 1985 Edition, except that the minimum steel thickness shall be 24 gauge; and all ductwork with the longest side 84 inches or greater shall be constructed of 16 gauge steel.
8. See SMACNA Manual for reinforcement.

2.02 Round and Flat Oval Ductwork

A. Acceptable Manufacturers and Models:

1. United McGill: Uni-Duct
2. Semco
3. Nexus
4. Norlock

B. All duct and fittings shall be manufactured by a company for whom the manufacturer of spiral duct has been a principal business for at least 10 years.

C. Manufacturer must submit a static regain design computerized printout, showing the performance of the manufacturer's ductwork in the system. This printout shall include, but not be limited to, the following:

1. Duct size.
2. Volume flow.
3. Velocity.
4. Static or total pressure drop (or regain) through the take-off or branch fittings.
5. Cumulative pressure drop through all duct fittings.
6. Duct pressure drop.
7. Component pressure drops.
8. Cumulative static or total pressure drop (or regain) for the system.
9. Outlet or inlet static pressure drop.
10. An acoustical analysis report for all terminal outlets.

D. Ductwork shall conform to SMACNA round ductwork standards.

E. Ductwork shall be constructed of galvanized sheet metal, ASTM A527/A527M.

F. Ductwork shall be of spiral lockseam construction.

G. Provide beaded sleeve or flanged and gasketed joints.

H. All elbows shall be standing seam construction or fully welded.

I. All take-off or branch entrances shall be by means of factory-fabricated fittings and of conical, low-loss, or straight construction.

J. Double-wall (insulated) duct shall be provided where indicated on the drawings.

1. All insulated duct diameters shown on drawings are inner dimensions.
2. Insulated duct shall be constructed of a perforated inner liner, a 1-inch layer of fiberglass, and an outer galvanized spiral duct pressure shell.

K. The spiral duct system, including all related parts including, but not limited to, air duct silencers, fire/smoke dampers and terminal units shall not exceed a total pressure drop of 4.5 in. w.c.

PART 3 EXECUTION

3.01 INSTALLATION

A. Ductwork:

1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (55 leakage) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Duct system shall be sealed to Class C requirements. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
2. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
3. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise, indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces,

conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

4. Electrical Equipment Space: Do not run ductwork through electrical equipment spaces and enclosures.
5. Where ducts pass through interior partitions conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".
6. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
7. Support ductwork in manner complying with SMACNA "Low Pressure Duct Standards - 5th Edition" hangers and supports section.

B. ROUND AND FLAT OVAL DUCTWORK

1. Round ducts shall be constructed in accordance with SMACNA Round Duct Construction Standards.

    a. Supply air shall be built to 10 in. w.c. maximum static pressure requirements.
    b. Return/exhaust air shall be built to 2 in. w.c. maximum static pressure requirements.

2. Flat oval ducts shall be constructed in accordance with SMACNA Flat Oval Duct Construction Standards.

    a. Supply air shall be built, and reinforced, to 10 in. w.c. maximum static pressure requirements.

3.02 SEALING AND PRESSURE TESTING DUCTS

A. As a minimum, seal all ducts according to SMACNA Seal Class A.

B. Lock all seams in ductwork and hammer flat; make absolutely tight against air leakage. Lap joints with inside lap in direction of air travel. Install sufficient slip joints in the ducts to take care of expansion and contraction.

C. Test for pressure leaks according to the SMACNA "HVAC Air Duct Test Manual" to achieve leakage Class 3 duct leakage level.

1. The following ductwork shall be pressure tested.

    a. Supply air ductwork

b. Exhaust ductwork between the terminal device (i.e. hoods, grilles, etc.) and the exhaust fan and between the exhaust fan and the discharge device (i.e. louvers, penthouses, etc.).

2. All ductwork failing the pressure test shall be resealed and retested until the pressure test is passed. The Architect/Engineer shall be present during testing.
3. The sealing material shall be of the liquid, mastics, gaskets and tape types. The sealing material shall be applied per the manufacturer's written recommendations and shall be compatible with the duct material, the air quality within the duct and the location of the duct.

3.03 CLEANING AND PROTECTION

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment of air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION 23 31 13

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SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section includes the requirements for ductwork accessories required for the work.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 05 93 – Air Systems Testing, Adjusting and Balancing.
2. Section 23 31 13 – Ductwork.

1.03 REFERENCE TO STANDARDS

A. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, First Edition".

B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

C. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems," pertaining to installation of ductwork accessories.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Product data: Provide manufacturers data sheets for the following:

1. Locking quadrants.
2. Turning vanes.
3. Flexible connections.
4. Duct Take-offs.
5. Dampers.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification.

C. Store new materials in original wrapping and protect from weather and construction traffic.

D. Protect new materials against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 VOLUME DAMPERS

A. Approved Manufacturers:

		Up to 12" high	Over 12 high
1.	Air Balance	AC-111	AC-2
2.	Air Louvers and Dampers	DG-10	DG-12

		Up to 12" high	Over 12 high
3.	Arrow United	150VCD	395
4.	Dowco	AVS	AVO
5.	Ruskin	MD25	CD35
6.	Vent Products	5101	5103

B. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC" Duct Construction Standards".

C. Manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers shall be capable of 100% shut-off of air movement in the duct. Dampers shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated and as required to properly balance the system.

2.02 DUCT TAKE-OFFS FOR FLEXIBLE DUCTS

A. Acceptable Manufacturers:

1. Flexmaster - Type STO (tapered side)
2. Flexmaster - Type STOC (conical side)
3. Sheet Metal Connectors, Inc. - H.E.T.

B. For branch ducts serving only one diffuser, take-offs shall have the following features:

1. Adhesive coated closed cell neoprene gasket for minimum air leakage.
2. 24 gauge, G-90 galvanized steel construction.
3. 1" wide mounting flange with die-formed corner clips.
4. Prepunched mounting holes.
5. Volume damper with locking handle mounted on 1-inch insulation stand-off.
6. Rectangular-to-round transition.

a. 45 deg. tapered side for attachment to standard rectangular duct runs.
b. Conical sides for attachment to closed loop rectangular duct loops.

2.03 DUCT SLEEVES, FRAMED PREPARED OPENINGS, CLOSURE COLLARS

A. Duct Sleeves. Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1-inch clearance between the duct and the sleeve or 1-inch clearance between the insulation and the sleeve for insulated ducts.

B. Framed Prepared Openings: Openings shall have 1-inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

C. Closure Collars: Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars

shall be installed with fasteners on maximum 6-inch centers, except that not less than 4 fasteners shall be used.

2.04 AIR FILTERS

A. Air Filters: Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

B. Replaceable Media Filters: Replaceable media filters shall be the dry-media type, of the size required to suit the application. Filtering media shall be not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Pad shall be enclosed in a holding frame of not less than 16-gauge

galvanized steel, and equipped with quick-opening mechanism for changing filter media. The air flow capacity of the filter shall be based on net filter face velocity not exceeding 300 feet per minute, with initial resistance of 0.13 inches water gauge. Average efficiency shall be not less than 30 percent when tested according to ASHRAE 52.

C. Holding Frames: Frames shall be fabricated from not lighter than 16-gauge sheet steel with rust-inhibit coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.05 DUCT ACCESS DOORS

A. Approved Manufacturers:

1. CESCO
2. Air Balance
3. Ruskin
4. Keys

B. Duct Access Doors: Access doors shall be provided in ductwork where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be 22 gauge galvanized steel with an extruded aluminum frame and esther gaskets. Latches shall be zinc plated. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 by 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 by 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.06 TURNING VANES

A. Acceptable Manufacturers:

1. Anemostat products Div.,: Dynamics Corp. of America.
2. Hart & Cooley Mfg. Co.
3. Approved Equal

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set 2" o.c., and set into side strips suitable for mounting in ductwork.

2.07 DUCT HARDWARE

A. Acceptable Manufacturers:

1. Hart & Cooley Mfg. Co.
2. Ventfabrics, Inc.
3. Young Regulator Co.

B. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.08 FLEXIBLE CONNECTIONS

A. Acceptable Manufacturers:

1. American/Elgen Co.; Energy Div.
2. Duro Dyne Corp.
3. Flexhaust (The) Co.
4. Ventfabrics, Inc.

B. General: Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.09 FIRE DAMPERS

A. Acceptable Manufacturers and Models:
1. Ruskin - Model - DIBD2
2. Vent Products
3. Safe Air
4. Air Balance

B. Fire dampers shall have the following features:

1. U.L. label.
2. One piece steel frame.
3. Steel blades with interlocking joints. Blades completely out of air stream.
4. Stainless steel negator closure spring if required for horizontal mounting.
5. 160 deg. F. U.L. listed fusible links and blade locks.

6. Dynamic closure rating: Dampers shall be classified for dynamic closure to 2000 FPM and 4 inches W.G. static pressure.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply. Return and exhaust air systems, and elsewhere as indicated.

C. Install flexible duct connections wherever ductwork connects to vibration isolated equipment.

D. Install thermometer in each air handling unit outdoor air intake duct, mixed air plenum, supply duct and return air duct in Mechanical Equipment Rooms.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer touch-up paint.

3.05 VOLUME DAMPERS.

A. Provide volume dampers where shown on the drawings and specified to properly equalize the ventilating systems.

B. Ventilation Contractor shall provide volume dampers at all locations, as required by the Testing and Balancing Contractor.

C. Construct the dampers so that there will be no movement in the damper when the systems are in operation.

D. Install extension rods and provide locking adjustable quadrants.

E. After installation of volume dampers, safe off and caulk between frame of damper and duct or opening to prevent air leakage around perimeter of damper. Leakage rate shall not exceed SMACNA's Leakage Class 3 Level.

3.06 FIRE DAMPER INSTALLATION

A. Mounting of damper shall be in accordance with UL conditions for rating and shall include a connection with ductwork using a plain "S" slip connection or similar connection as used throughout supply duct system.

B. After installation of smoke and combination fire and smoke dampers, safe off and caulk between frame of damper and duct or opening to prevent air leakage around perimeter of damper. Leakage rate shall not exceed SMACNA's Leakage Class 3 Level.

C. The fusible link of every fire damper shall be accessible. Provide an access door in the ductwork adjacent to the fire damper unless shown otherwise.

D. The access panel shall be large enough that the fusible link can be reset using both hands and positioned so the link may be reached.

END OF SECTION 23 33 00

SECTION 23 34 00
POWER VENTILATORS

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The extent of work as required by the drawings and these specifications. This work includes roof exhausters and associated mounting hardware, as required to provide complete and operational ventilation and exhaust systems.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 05 93 – Air Systems Testing, Adjusting and Balancing.
2. Section 23 31 13 – Ductwork.

1.03 REFERENCE TO STANDARDS

A. UL

B. NEC

C. AMCA

D. ASHRAE

E. SMACNA

F. American Conference of Governmental Industrial Hygienists, "Industrial Ventilation, 21st Edition"

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 5 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit under the provisions of Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, power requirements, wiring diagrams, etc.

C. Product Data:

1. Provide data on operating equipment characteristics for each fan.
2. Rooftop supports and roof curbs.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept material on site in shipping containers with labeling in place. Inspect for damage.

PART 2 PRODUCTS

2.01 CEILING MOUNTED CABINET FANS

A. Acceptable Manufacturers:

1.	Penn	ZJ
2.	Carnes	VCD
3.	Greenheck	SP
4.	Cook	Gemini
5.	Breidert	BF
6.	Acme	V

B. General Description: Ceiling mounted, centrifugal, direct drive exhaust fan. Unit shall be UL listed and bear the AMCA Certified Ratings Seal for sound and air

performance.

C. Housing: Heavy-gage, galvanized steel fan casing.

D. Fan Wheel: Steel centrifugal wheel.

E. Fan, motor and wheel shall be able to be removed without disturbing housing.

F. Grille shall be constructed of non-yellowing high strength polymer and shall comply with all OSHA requirements.

G. Accessories: Fan shall be supplied with the following accessories.

1. Wall switch control.
2. Hooded Wall Cap
3. Counter balanced gravity backdraft damper.
4. Hanging vibration isolators

PART 3 EXECUTION

3.01 PREPARATION

A. Visually inspect for signs of damage, impact damage would appear as whitening of the surface or star shaped cracks or crazes.

3.02 FAN INSTALLATION

A. Install fans where shown on plans. Exact equipment locations shall be coordinated with all other contractors and trades. Any equipment installed without the proper coordination shall be removed and reinstalled at the expense of that Contractor.

B. Coordinate exact opening sizes with equipment manufacturer.

C. Check all bolts to assure that none have loosened.

D. Before wiring the motor, rotate fan wheel by hand to check for free rotation and to assure that the impeller has not shifted such that it would be rubbing against the fan housing.

E. Install all accessory equipment that is not already preassembled with fans.

F. Run conduit from inside building, along inside corner of the curb to the junction box.

G. Safety disconnect and motor overload protection shall be tested upon successful completion of installation.

H. All fans, dampers and controls shall be tested after installation for correct operation, current draw and air flow.

I. Fans shall be installed as detailed on the plans and as required by the manufacturer. Contractor shall maintain minimum service clearances as required by manufacturer.

J. All equipment shall be set or hung level and securely fastened in place and shall be set or hung true to building wall lines.

END OF SECTION 23 34 00

SECTION 23 37 00
AIR INLETS AND OUTLETS

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes all supply, return and exhaust air inlet and outlet devices including grilles, registers, and louvers.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 05 93 – Air Systems Testing, Adjusting and Balancing.
2. Section 23 31 13 – Ductwork.
3. Section 23 31 16 – Fabric Ductwork.
4. Section 23 33 00 – Ductwork Accessories.

1.03 REFERENCE TO STANDARDS

A. Referenced standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance. Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters."
4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

1. Schedules: Submit schedule(s) for all items. Schedules shall be formatted to match those provided with the specification and drawings for ease of comparison and shall contain all rated performance information.
2. Product Data: Provide manufacturers data sheets for each type of air outlet

and inlet, and accessory furnished; indicating construction, finish, performance, and mounting details for each of the following items:

a. Diffusers.
b. Registers.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification.

C. Store new materials in original wrapping and protect from weather and construction traffic.

D. Protect new materials against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 DIFFUSERS, REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Air devices shall be supplied with sponge rubber gaskets for airtight installation

B. Performance: Provide ceiling diffusers that have, as minimum, temperature velocity traverses, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of ceiling air diffuser.

D. Diffuser Finishes:

1. White Enamel (W-E): Semi-gloss white enamel prime finish.
2. Air Devices shall be supplied with color matched sheet metal screws.

MANUFACTURERS

	ANEMOSTAT	CARNES	METAL AIR	TITUS	PRICE
SCHEDULE TYPE:					
A	EPL	SFTB	5800	TMS-A	ASCD
D	PJ	CHFB	FTS	FL-10	AST
B	GC5L	6295H	CC5	50F	80
C	X2H	6825H	H4004	272FL	32DAL/L

2.02 LOUVERS

A. Acceptable Manufacturers:

1.	Ruskin	ELF375D
2.	American Warming & Ventilating	LE-21
3.	Greenheck	ESD-403
4.	Arrow United	465-35
5.	Dowco	DBE
6.	Louvers & Dampers, Inc	
7.	Vent Products	

B. General: Drainable louvers where shown; of size, shape, and capacity indicated; designed for a wind load of 20 psf.

C. Performance: Provide louvers that have maximum free area, and minimum pressure drop for each type as listed in manufacturer's current data, complying with louver schedule. Louvers to have maximum of 0.01 oz/sf of water penetration.

D. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation.

E. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld

units or use stainless steel fasteners.

F. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

2.03 MOTORIZED DAMPERS

A. Acceptable Manufacturers:

1. Ruskin - Model IL35
2. Dowco
3. Arrow United
4. Air Balance
5. Vent Products

B. Provide insulated motorized dampers where shown, and of sizes as scheduled, on the drawings.

C. Construction to have the following features:

1. Blades shall 6" wide, 16 gage galvanized steel on 6" centers. Insulation shall be completely enclosed with galvanized steel outer skin. Blade edge seals shall be PVC coated polyester fabric.
2. Damper shall be of opposed-blade type and equipped with permanently lubricated stainless steel sleeve bearings.
3. Have interlocking edges with extruded vinyl blade seals and flexible metal, compressible jamb seals.
4. Damper linkage shall be concealed in damper frame.
5. Air leakage shall not exceed 4-cfm/square foot.
6. Have solid stops on all four sides.
7. Damper shall be complete with provisions for installation of actuator and linkages.
8. Dampers shall be complete with control shaft extension. End of shaft shall be notched to indicate damper blade position. Outboard support bearings shall be provided with all single section dampers for field mounted actuators. Factory installed jackshaft shall be provided with all multiple section dampers.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed.

Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 DIFFUSERS, REGISTERS AND GRILLES INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers and registers as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

D. Adjust throw to not exceed velocities of 50 FPM in occupied zones.

E. Install diffusers, registers and grilles in a manner that they will be vibration free during operation.

F. Where the interior surfaces of ductwork are visible through the face of diffusers, registers and grilles, paint interior visible surfaces with one coat of flat black acrylic paint.

3.03 LOUVER INSTALLATION

A. General: Install louvers and dampers as shown on the drawings and in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

3.04 MOTORIZED DAMPERS

A. Install damper plumb and square with proper alignment.

B. Install damper with proper orientation to airstream.

C. After installation of motorized damper, safe-off and caulk between frame of damper and duct or opening to prevent air leakage around perimeter of damper. Leakage rate shall not exceed SMACNA’s Leakage Class 3 level.

D. Each motorized damper installation shall allow observation of damper operation.

END OF SECTION 23 37 00

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SECTION 23 62 00
AIR COOLED CONDENSING UNITS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers the general requirements for all air cooled condensing units and associated equipment procured under this contract.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 07 18 - Refrigerant Piping Insulation.
2. Section 23 23 00 - Refrigerant Piping and Specialties
3. Section 23 73 01 - Furnaces

1.03 REFERENCE TO STANDARDS

A. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

C. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.

D. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.

E. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

F. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State of Illinois and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, power requirements, wiring, diagrams, etc.

C. Product Data: Provide data on operating equipment characteristics for:
1. Air Cooled Condensing Unit.
2.. 5 year warranty.

PART 2 PRODUCTS

2.01 AIR COOLED CONDENSING UNITS: ACCU-1

A. Acceptable Manufacturers:

1. Carrier 24ABC6
2. Trane
3. Approved Equal

. General: Provide factory-assembled and tested air-cooled condensing units as indicated, consisting of compressor, condenser coil, fan, motor, refrigerant reservoir, holding charge (R-410A), and operating controls. Provide capacity and electrical characteristics as scheduled. Provide vibration isolation as required by the

manufacturer.

B. Casing: Provide 18 ga. galvanized steel casing finished with baked enamel. Provide removable panel for access to controls, and weep holes for water drainage. Provide base with mounting holes. Provide brass service valves, fittings, and gage ports on exterior of casing.

C. Compressor: Provide reciprocating hermetically sealed with built-in overloads and vibration isolation. Provide for compressor motor, thermal and current-sensitive overload device, internal high-pressure cutout switches, start capacitor and relay, 2-pole contactor, crankcase heater, and temperature actuated switch and timer to prevent compressor rapid cycle.

D. Condenser: Construct coil of copper tubes circulated for integral subcooler and aluminum fins, provided with liquid accumulator and liquid subcooler. Provide aluminum propeller fan, direct driven, with permanently lubricated fan motor with thermal overload protection. Coils fabricated with aluminum tubes will not be accepted.

E. Refrigeration Components: Refrigeration circuit components shall include a liquid line service valve, suction line service valve, liquid dryer, a full charge of compressor oil and a holding charge of refrigerant.

F. Controls and Safeties: Minimum control functions shall include, control wire terminal blocks, five minute recycle protection to prevent compressor short cycling. Included with unit shall be a programmable/communicating thermostat to allow the programming of cooling/heating setbacks and set-ups with provisions for weekends and holidays. Minimum included safety devices shall include a high discharge pressure cutout, low suction pressure cutout.

G. Direct expansion coil and air cooled condensing unit shall be matched as to performance and capacity and shall be of same manufacturer.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air cooled condensing units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Architect/Engineer.

3.02 INSTALLATION OF AIR-COOLED CONDENSING UNITS

A. General: Install air cooled condensing units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Provide all control wiring for unit operation as required. Contractor to provide disconnect switch sized for service required. Power wiring to all motors and disconnect switch shall be under Electrical work

B. Air cooled condensing units: Connect refrigerant piping to unit; run piping so as not to interfere with access to unit or use of building equipment or features.

1. Install furnished field-mounted accessories.
2. Provide roof supports for refrigerant piping as required.
3. The refrigerant piping shall be sized by manufacturer’s recommendations, submitted and approved by the Engineer.
4. Charging valves, expansion valve, solenoid valve, back seating type service valves, and any other valves necessary for thge safe and proper operation of the refrigerating system shall be included in the installation. Seal caps shall be used on all refrigerant valves.
5. A suitable refrigerant filter-dryer which can be serviced without breaking the inlet and outlet refrigerant connections shall be installed in the liquid line on the supply side of the solenoid valve.
6. The suction piping shall have an oil trap and the suction line shall pitch down in the direction of flow.

C. Start-up air cooled condensing units, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

D. Provide Owner extended warranty, 5 year minimum.

END OF SECTION 23 62 00.

SECTION 23 73 01
FURNACES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of work as required by the drawings and these specifications. Work includes all terminal heating, ventilation and air conditioning units.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 23 62 00 – Air Cooled Condensing Units.
2. Section 23 31 13 – Ductwork.

1.03 REFERENCE TO STANDARDS

A. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

B. ASHRAE 90A - Energy Conservation in New Building Design.

C. NEMA MG 1 - Motors and Generators.

D. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

E. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

F. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.

G. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier

who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State of Illinois and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, power requirements, wiring, diagrams, etc.

C. Product Data: Provide data on operating equipment characteristics for:

1. Furnace
2. Thermostat

1.06 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 EXTRA MATERIALS

A. Provide two sets of filters for each air handling unit.

PART 2 PRODUCTS

2.01 FURNACE: F-1

A. Acceptable Manufacturers - Subject to compliance with specifications:

1. Carrier 59SC5A/CAPVP

2. Trane
3. Accepted equal

B. Vertical upflow configuration, high efficiency, 4-way multipoise, direct vent, condensing natural gas fired furnace.

C. Sealed combustion system with PVC pipe providing vent and combustion air directly to the unit.

D. Redundant gas valve with one gas control and two internal shutoff valves. Unit shall operate on gas pressures from 5 inches w.c. to 11 inches w.c.

E. Hot surface ignitor.

F. Serpentine primary heat exchanger constructed of solid, weld free aluminized steel. Insulated heat exchanger section.

G. Secondary condensing heat exchanger constructed of polypropylene laminated steel.

H. Heat exchangers shall have a 20 year warranty.

I. Adjustable speed, constant volume blower.

J. Microprocessor controls for sequencing and furnace operation. Unit shall be equipped with 24 volt transformer for control power.

K. Cleanable filter with retainer.

L. Forward curved blower wheel, factory balanced, with permanently lubricated ball bearings. Blower access panel switch to shut off blower when panel is opened.

M. Insulated galvanized steel drain pan.

N. A-coil section with aluminum tube / aluminum fin coils. Coils shall be leak tested to 250 psig at 200 degree F.

1. ARI-rated performance ratings and UL listed.
2. Thermostatic Expansion Valves (TXV)
3. Corrosion--resistant drain pan designed with a fiberglass reinforced thermoset polyester and sloped to help ensure water drainage, reduced pan sweating and improved moisture removal
4. Refrigerant Connections - sweat connections for leak-free operation maintaining system reliability.
5. Side mounting tubing to the coil slabs
6. Burst Pressure to 2100 psi

O. Accessories shall include but not be limited to the following”

1. 3” PVC vent and combustion air piping with concentric vent termination kit.
3. Throw-away filter (1” minimum thickness).
2. Humidifier.
4. Seven day programmable thermostat.
5. Air cooled condensing unit with capacity matched to cooling coil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that floors are ready for installation of units and openings are as indicated on shop drawings. Verify that supports for air cooled condensers are completed.

C. Verify that proper power supply is available for furnace and condenser package.

D. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

A. Install in accordance with NFPA 90A.

B. Install refrigeration systems in accordance with ASHRAE 15.

C. Unit shall be configured and installed such that the motors, drives, and fan bearings are accessible and the coils are removable. Provide a minimum 36” clearance to the front of the unit, with a minimum 1” clearance to combustibles on all other sides.

D. Pipe drain from cooling coils, humidifiers to nearest floor drain.

E. Mount air cooled heat pump package on roof curb.

F. Suspend unit from roof structure. Provide vibration isolation as required by manufacturer.

G. Mount thermostat where shown on the drawings at a height of 48" above finished floor.

END OF SECTION 23 73 01

SECTION 26 01 26
TESTING ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Contractor shall note that this section shall be considered a Supplement to testing requirements outlined or described in other sections of these specifications.

1.02 WORK INCLUDES

A. Extent of Work as required by the Drawings and these Specifications

1.03 RELATED WORK

A. Specified elsewhere:
   1. Section 26 05 00 – Common Work Results for Electrical
   2. Section 26 05 19 – Low Voltage Conductors and Cables
   3. Section 26 05 26 - Grounding and Bonding for Electrical Systems
   4. Section 26 05 85 - Mechanical Equipment Wiring
   5. Section 26 27 16 – Electrical Cabinets and Enclosures
   6. Section 26 28 16 - Enclosed Switches and Circuit Breakers
   7. Section 26 29 01 – Common Motor Requirements (600 Volts and Below)
   8. Section 26 29 13 - Enclosed Controllers

1.04 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Governing Codes:
      a. NFPA 70 – National Electrical Code (most current issue)

1.05 SUBMITTALS

A. Submit under provisions of Division 1.
   1. Test Reports:
      a. Test of entire electrical system as noted herein. Submit to the Engineer in triplicate.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish all equipment, tools, manpower, and labor to perform specified testing.

PART 3 EXECUTION

3.01 TESTING

A. After wires and cables are in place and connected to devices and equipment, the system shall be tested for short circuits, improper grounds, and other faults. When fault condition is present, the trouble shall be rectified, then re-tested. Where cable is found defective or damaged, it shall be removed and replaced in entirety; do not field repair. Cost for correction shall be considered incidental to the project.

B. All wiring devices and electrical apparatus furnished under this contract, when ground or shorted on any integral "live" part, shall be removed and the trouble rectified by replacing all defective parts and materials. Cost of correction is considered incidental to the project.

C. All feeder cables and other power distribution apparatus shall have a Megger resistance test conducted to determine that insulation resistance is not less than that recommended by the manufacturer, or as noted below.

Unless otherwise recommended by the manufacturer, insulation resistance testing shall meet or exceed the following on 600 Volt equipment utilizing 500 Volt resistance test instrument:

Conductors.....50 Meg-Ohms
Motors…….5 Meg-Ohms
Switchboards, MCC's and Panelboards .....25 Meg-Ohms
Power Transformers.....5 Meg-Ohms

D. Contractor shall furnish all tests and shall provide all test equipment, meters, instruments, cable connections or apparatus necessary for performing tests as specified herein. All costs for testing shall be considered incidental to this item and will not be paid for separately.

E. Examine connections to equipment for proper phase relationships. Rotate phase conductors as necessary in order to correct.

F. All motors shall be tested under Section 26 29 01. All motors shall be tested for correct direction of rotation. Run tests on all motors shall be tested for correct direction of rotation. Run tests on all motors and verify that proper overload devices have been installed. Coordinate this task with motor supplier.

G. Testing of Ground System

1. Each and all grounded cases and metal parts associated with electrical equipment shall be tested for continuity of connection with the ground bus

system by the Contractor in the presence of the Engineer or his representative.

2. All grounding electrode conductors brought in from the ground field shall be tested for satisfactory continuity and by resistance measurement between the electrical equipment ground bus and the ground field. The grounding path shall not exceed 0.010 ohms.

3. Each Ground Field shall be tested for resistance to earth a "three-terminal" or "fall-of-potential" test as described in IEEE Standard #81. As an alternate, a specially designed clamp-on instrument such as AEMC Model 3710 (now superseded by Model 6416) or 3730 (now superseded by Model 6417) may be used if found acceptable to the engineer. Based upon measured field data, the Contractor shall calculate the ground field resistance and furnish record copies to the Engineer and Owner for record. In no case shall the ground field resistance exceed 25 ohms. If the resistance is found to be higher than 25 ohms, one additional rod shall be driven with a minimum separation equal to the length of the ground rod used and connected in parallel with the rod under test.

4. Exterior ground field resistance testing shall not be measured during unusually wet weather and should be performed during normal weather and soil conditions. Any tests incorrectly performed or not performed to the satisfaction of the engineer will be repeated. Costs for all such re-testing shall be considered incidental to the project.

5. All specified maximums and minimums of this specifications must be met. Complete test records of all tests shall be made and shall show resistance values obtained and calculations of same, showing method of test and calculation.

3.02 CORRECTION OF DEFECTS

A. When tests disclose any unsatisfactory workmanship or equipment furnished under this contract, correct defects and retest. Repeat tests until satisfactory results are obtained.

B. When any wiring or equipment is damaged by tests, repair or replace such wiring or equipment. Test repaired items to ensure satisfactory operation.

END OF SECTION 26 01 26

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is general in nature and applicable to electrical system work. Contractor is also directed to other sections of Division 26 - Electrical for additional related specifications for items described in this section.

B. Work included in this section shall apply to installation and testing of all materials and equipment necessary to completely install electrical system as shown on drawings and as described herein in these specifications, or as may be necessary for a complete and operational electrical system.

C. Unless otherwise noted, all electrical equipment shown on project drawings shall be furnished under Division 26.

D. Drawings pertaining to this installation indicate general location of conduits, wiring, distribution and motor control centers, lighting and outlets, and other details necessary for installation of system.

E. Electrical installation as shown on drawings and as specified herein is based upon best available information, with regard to characteristics of mechanical equipment specified. In the event changes are necessary in order to accommodate mechanical equipment furnished, necessary revisions will be made with approval of Owner’s representative.

F. Any minor changes in location of equipment, to include conduits, outlets, etc., from those shown on drawings, shall be made without extra charge if so directed by Owner’s representative. These changes shall be any changes in location that, had new location been the bid-upon location, would not have resulted in an increase in contract construction cost over that actually bid.

G. All electrical equipment shall be installed in conformance with applicable sections of NPFA 70 - National Electrical Code, respective equipment manufacturer's directions, as detailed on drawings and as specified herein. Any installations which void U.L. listing (or other third-party listing) and/or manufacturer's warranty of a device or equipment shall NOT be permitted.

H. RELATED CONTRACT WORK DESCRIBED ELSEWHERE IN THESE SPECIFICATIONS:

Electrical Contractor shall note that it is not the intent of these Division 26 specifications herein to be all-inclusive of electrically related work to be performed as part of this contract.

Contractor shall also comply with electrical requirements in these sections of the

specifications, including, but not limited to, wiring of motors, control panels furnished by others, HVAC equipment and all other electrically powered equipment furnished by others under this project.

1.02 LAWS AND ORDINANCES

A. In installation of this work, Contractor shall comply in every respect with requirements of National Electrical Code (NEC), National Board of Fire Underwriters, and any state and local requirements, laws and ordinances as may be applicable.

B. If, in opinion of the Contractor, there is anything in drawings or specifications that will not strictly comply with above laws, ordinances and rules, the matter shall be referred to the attention of the Owner's representative for a decision before proceeding with that part of the work. No changes on drawings or in specifications shall be made without the full consent of Owner's representative.

C. Contractor shall obtain and pay for all licenses, permits and inspections required by above laws, ordinances and rules for entire electric wiring job called for in these specifications and accompanying drawings.

1.03 DRAWINGS

A. Drawings for electrical work will be a part of electrical drawings to which will be added, during the period of construction, any other detail drawings as may be necessary in opinion of Owner's representative, to show proper installation of various appliances or equipment with relation to project.

B. Drawings and specifications are intended to be descriptive only, and any error or omissions of detail in either shall not relieve Contractor from obligations thereunder to install in correct detail any and all materials necessary for complete and operating electrical systems to extent shown on drawings and described in this specification.

C. Contractor shall, during progress of job, record any and all changes or deviations from original drawings, and, at completion of project, shall deliver to Owner's representative a single marked-up set of "as-built" drawings.

1.04 SHOP AND ERECTION DRAWINGS

A. This Contractor shall prepare shop drawings for all parts of his work. Before commencing any work or providing any material, Contractor shall submit for approval of Owner's representative all drawings relating to construction, arrangement or disposition of equipment entering into contract, and show complete equipment with manufacturer's specifications of same.

B. Shop drawings of all distribution and motor control centers, panels, power and lighting systems, fixtures, wire, cables, devices, etc. shall be submitted for approval, as well as complete details of all systems not shown in detail on drawings.

C. Shop drawings shall be fully descriptive of all materials and equipment to be incorporated into this project. Contractor shall carefully check all submitted shop drawings, making sure they are complete in all details and cover specific items as hereinafter specified.

D. Shop drawings shall be submitted in sufficient quantity as required by the General Conditions.

E. No material or equipment shall be allowed at the site until shop drawings approved by the Engineer are received by the Resident Engineer at the site.

F. The following information shall be clearly marked on each shop drawing, catalog cut, pamphlet, specifications sheet, etc. submitted:

PROJECT TITLE:
BRANCH OF WORK: ELECTRICAL
NAME OF BUILDING OR LOCATION:
PAGE OF DRAWINGS OR SPECS WITH WHICH EQUIPMENT COMPLIES:
DATE:
SUBMITTED BY:

PART 2 PRODUCTS

2.01 PRODUCTS SHALL BE AS SPECIFIED IN OTHER SECTION AND AS DETAILED ON THE DRAWINGS

PART 3 EXECUTION

3.01 EQUIPMENT STORAGE

A. Except as indicated below, all electrical equipment considered to be a part of this contract shall be stored before installation in a warm, dry, indoor area so as to protect the equipment from physical damage, freezing, dirt and any other harmful effects.

B. The following electrical equipment shall be permitted to be stored outdoors on pallets or without direct contact with the earth, under tarpaulins or plastic covers:

1. Conduit. Does not include boxed fittings, etc., which shall be stored indoors.
2. Cable Tray. Does not include boxed hardware, which shall be stored indoors.
3. Ground Rods.
4. Wire and Cable.
5. Rebar.
6. Strut-type framing members. Does not include boxed hardware, which shall be stored indoors.

7. Other electrical equipment not listed herein, with written approval of the Owner's Authorized Representative.

C. The following electrical equipment shall be permitted to be stored exposed outdoors on pallets or without direct contact with the earth:

1. Light Poles. Does not include light fixtures or boxed hardware, which shall be stored indoors.
2. Other electrical equipment not listed herein, with written approval of the Owner's Authorized Representative.

D. The installation of electrical equipment shall not begin until the structure, if required, within which the equipment is to be permanently housed, is complete enough to provide protection from weather and vandalism (i.e. roof, windows and temporary padlockable or permanent doors installed).

E. The Contractor will be responsible for ensuring conformance with these procedures.

3.02 EQUIPMENT MOUNTING

A. All equipment and materials shall be installed and completed in a first-class workmanlike manner. The right is reserved to direct the removal and replacement of any item, which in the opinion of the Owner's Representative and/or Architect/Engineer does not present an orderly and reasonably neat or workmanlike appearance, provided such items can be properly installed in an orderly way by usual methods in such work.

B. The approximate location of all equipment and devices is shown on the Drawings. The Owner's Representative and/or Architect/Engineer reserves the right to change the location of all equipment or devices 6 ft in any direction at no additional cost provided such changes are requested before final installation.

C. Install all equipment with ample space allowed for removal and repair. Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment which is installed or which is already in place. Provide access panels for all devices installed above non-accessible ceilings and/or within walls or partitions.

D. Install electrical equipment with due consideration to ventilating ducts, HVAC equipment, mechanical piping, etc., adjusting locations as necessary.

E. Electrical equipment shall be installed to maintain minimum clearances per Article 110 of NEC and ANSI C2 (National Electrical Safety Code.)

F. Electrical Contractor shall be responsible for furnishing and setting all anchor bolts required to install Electrical Contractor's equipment.

G. Where concrete mounting pads are required for electrical equipment mounting, Electrical Contractor shall furnish all concrete and form work necessary to complete the installation.

H. Where electrical equipment is located on damp or wet walls or locations as directed, it shall be "stand-off" mounted a minimum of ½" from wall in a manner so that rear of equipment is freely exposed to surrounding air. Method of mounting shall be approved by Owner's representative before equipment is mounted.

I. Unless otherwise noted, top of safety-switches, control panels, and similar equipment shall be 5'-0" above finish floor or finish grade.

J. Enclosures for panelboards, switches or overcurrent devices shall not be used as junction boxes, auxiliary gutters or raceways for conductors feeding through or tapping-off to other switches or overcurrent devices, unless adequate space for this purpose is provided and the equipment is listed for this use.

K. In order to maintain NEC ratings and classifications of cables, do not combine conduit contents or modify conduit materials of construction unless specifically directed or shown otherwise on project documents.

L. Per NEC 300.11(A)(2), when independent electrical equipment support wires are installed within dropped-ceiling areas, they shall be distinguished by color, tagging, or other permanent effective means.

3.03 COORDINATION

A. Provide day-to-day coordination with the work of other contractors engaged in this project. Execute the work in a manner not to interfere with other Contractors, and vice-versa.

B. Coordinate with other contractors regarding the location and size of pipes, raceways, ducts, openings, devices, so that there may be no interferences between installation or of the progress of any contractor.

C. Coordinate installation of equipment and wiring with the established construction schedule.

D. Provide temporary platforms and handrails as required, to allow installation of electrical components and raceway systems.

3.04 PROTECTION OF WORK

A. Protect work from injury by keeping all conduit and boxes capped and plugged or otherwise protected. This includes damage by freezing and/or stoppage from building materials, sand, dirt, or concrete.

B. Protect all equipment and fixtures from damages during the project, provide all tarpaulins, drop cloths, barricades, temporary heaters or auxiliary equipment.

C. All materials or equipment damaged during construction shall be repaired or replaced with new items to the satisfaction of the Architect/Engineer.

END OF SECTION 26 05 00

SECTION 26 05 05
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Work Includes

1. Electrical demolition.

B. RELATED WORK (RESERVED)

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT (RESERVED)

PART 3 EXECUTION

3.01 EXAMINATION

A. The drawings are intended to indicate the scope of work required and not to indicate every box, conduit, or wire that must be removed.

B. Where walls, ceilings, etc., are indicated as being removed on general plans, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, wiring, systems, etc., from the removed area.

C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.

D. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit, wire and equipment to facilities or equipment which shall remain in operation following demolition. Extension of conduit wire equipment shall be compatible with surrounding area.

E. Coordinate scope of work with all other Contractors and the Owner's representative at the project site. Schedule removal of equipment and electrical service to avoid conflicts.

F. Bid submittal means Contractor has visited the project site and has verified existing conditions and scope of work.

G. Prior to beginning any work, the Contractor shall field determine all existing circuits and equipment powered by these circuits in the areas of demolition.

3.02 PREPARATION

A. Disconnect electrical systems scheduled for removal.

B. Coordinate utility service outages with the Owner's representative.

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.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work as outlined in the plans.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Where possible, remove abandoned wiring and raceway to source of supply. Abandoned conduits which extend to below grade shall be removed to minimum of 1'-0" below grade and capped to prevent entry of water.

D. Remove exposed abandoned raceway. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

E. Disconnect abandoned outlets and toggle switches and remove devices. Remove abandoned outlets and toggle switches if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Place existing fluorescent ballasts in E.P.A. approved containers for P.C.B.'s and dispose of them in an E.P.A. approved landfill. Provide documentation that P.C.B. disposal requirements have been met.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CONTINUITY OF SERVICE DURING ELECTRICAL DEMOLITION

A. Contractor shall maintain continuity of service to all existing electrical equipment to be removed or replaced until such equipment is no longer needed to maintain process operation at the facility. This may require temporary relocation of equipment to be removed, temporary wiring of equipment to be removed and temporary power generation using portable generators as required to maintain operation of critical process equipment at the facility.

B. There shall be no power outages of any kind or duration whatsoever without the written consent of the owner's authorized representative. Failure to comply with this requirement could result in substantial penalty charges being assessed the contractor.

C. With assistance and approval of the owner's authorized representative(s), the contractor shall develop a written electrical demolition sequence schedule as part of the overall Electrical Construction Sequence Schedule. No electrical work shall begin without this written construction sequence schedule.

D. Prior to beginning of any work requiring a power outage of any kind or duration, the contractor shall have all labor, material and equipment on site and ready for use.

END OF SECTION 26 05 05

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Work included in this section is supply of wire and cable to provide a complete and operational electrical system.

B. Any bid submitted to the Owner which contains cost adjustments for the current price of metals (copper and/or aluminum) will be rejected. Qualified bids in any form will not be considered.

C. Unless otherwise specified or detailed on the project drawings, all wire and cable shall be installed in conduit.

D. Unless otherwise specified or detailed on drawings, all wire and cable on this project shall be copper construction only.

E. Related Sections
   1. Division 11 - Equipment
   2. Division 13 - Special Construction
   3. Division 23 – Heating, Ventilation, and Air Conditioning (HVAC)
   4. Section 26 05 00 – Common Work Results for Electrical
   5. Section 26 05 33 - Raceway and Boxes for Electrical Systems
   6. Section 26 05 26 - Grounding and Bonding for Electrical Systems

F. Reference to Standards
   1. ANSI/NFPA 70 - National Electrical Code
   2. U.L Standard No. 44 - Thermoset-Insulated Wires and Cables.
   3. IPCEA Publication No. S-66-524.
   4. Federal Specification J-C-30B
   5. ASTM Specification B-8.

1.03 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Division 01.

B. Contractor shall submit for all cable types and sizes used on this project.

1.04 QUALIFICATIONS

A. Wire and cable shall be manufactured and supplied by a company regularly engaged in business of furnishing wire and cable. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of five years in manufacture of wire and cable.

1.05 DELIVERY, STORAGE AND HANDLING

A. Wire and cable shall be delivered on reels or coiled in boxes. Wire and cables shall be stored and handled to prevent damage to conductor and insulation.

1.06 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. THHN/THWN

Unless otherwise noted on the plans or specifications, all interior and exterior power wiring installed under this project shall be dual rated type THHN/THWN.

Cable shall be 600 Volt rated, sized as indicated on the drawings. Cable shall comply with Underwriters Laboratories Standard U.L. 83. Cables shall be rated 90°C in dry locations 75°C in wet locations. Conductors shall be annealed copper.

B. CATEGORY 6 CABLE

1. UTP Cable to be 4 Pair, 23 AWG solid copper construction and Certified to TIA/EIA-568.2-D Category 6 requirements.
2. Cable shall accommodate transmission speeds up to 4.8 Gb/s.
   a. Riser cable shall be ITS/ETL Certified as CMP and listed as NEC type CMR per UL Standard 444. Riser cable shall be Belden DataTwist 4812 or equivalent.
   b. Plenum cable shall be NFPA 262, UL 910 (Plenum) FT6, listed as NEC type CMP per UL Standard 444. Plenum cable shall be Belden DataTwist 4813 or equivalent.

2.02 COLOR CODING

A. Color code conductor insulation for #10 AWG or smaller conductors. Color code conductors #8 AWG or larger with colored tape or colored insulation. Standard colors:

	120/240V 1 Phase 3W	240 V or 208/120V 3 Phase 3 or 4W	480V 3 Phase 3 or 4W	240/120V 3 Phase 4W, □
Phase A	Black	Black	Brown	Black
Phase B	Red	Red	Orange	Orange (high leg)
Phase C	N/A	Blue	Yellow	Blue
Neutral	White	White	Gray	White
Ground	Green	Green	Green	Green

B. Intrinsically safe wiring shall be light blue color insulation per ANSI/ISA RP12.6 and NEC 504 or per respective equipment manufacturer's recommendations.

C. Control wiring insulation color shall be red.

D. 120 VAC control wiring from a separate source (for example, 120 V control wiring from a control panel that supplies a remote located starter) shall be with yellow color insulation.

E. 24 VDC wiring shall be Blue for Positive and White with Blue Stripe for Negative.

2.03 WIRE PULLING LUBRICANT

A. Pulling lubricant shall be UL listed, water based, polymer solution. Lubricants containing waxes, soaps or combustible materials are not acceptable. Contractor shall verify the compatibility of the selected cable pulling lubricant and cable jacket materials proposed. Manufacturers/Lubricants shall be as follows, or equivalent:

1. American Polywater - Polywater J
2. Ideal Industries - ClearGlide
3. American Colloid - Poly-X
4. Buchanan - Quick Slip
5. ARNCO – HydraLube

2.04 SPLICES AND JOINTS

A. Splices and joints shall be as described below, or approved equivalent.

B. Interior applications:

1. #8 and smaller conductors:
   a. Ideal "sing nut" type insulated connectors.
   b. Scotchlok R, B, and Y type insulated connectors.
2. #6 and larger conductors:

a. New construction: For straight line connections, use compression connector with rubber insulating cover or boot.
b. New construction: For “Tee” cable taps, use compression connector with rubber insulating cover or boot.
c. Existing construction: For taps in cabinets, gutters and other close locations, use O-Z/Gedney type XW & XWC, XTP & XTPC or, PMX &PMXC, or equivalent.

C. Exterior applications

Note that below grade splices in manholes, handholes and vaults will not be allowed on this project unless specifically shown on drawings. Conductors are to be pulled continuous end-to-end unless otherwise noted or directed by the Engineer in writing.

1. #8 and smaller conductors:
   a. Twist-on connectors pre-filled with silicone-based sealant to protect against moisture and corrosion. Units shall be UL 486D listed as weatherproof, waterproof and suitable for direct burial. Units shall be Ideal Industries “Underground” #64 or King Innovation “Dryconn King 6 Blue” Filled Waterproof Connectors, or equivalent.
2. #6 and larger conductors:
   a. NSI/Polaris ISRW Series “Blue”
   b. Ilsco Series USPA, DBK, SSK or PDSS

2.05 LINE MARKING TAPE

A. Where required or noted on the drawings, line marking tape shall be installed as specified in Section 26 05 41 - Underground Electrical Construction

PART 3 EXECUTION

3.01 INSTALLATION (WIRE CONDUCTORS)

A. Wire and cable shall be installed using accepted industry methods to prevent damage to conductors and insulation. Installation shall comply with all applicable sections of NEC regarding conduit fill.

B. No splices shall be permitted in conduit bodies. All splices shall be made in junction boxes, control panels and cabinets provided for that purpose as detailed or required by need.

C. Neatly train and lace wiring inside boxes, equipment and panelboards.

D. Drawings are diagrammatic in showing circuitry routing between devices and equipment. Provide all phase conductors, neutrals, switched and unswitched legs, grounds, etc., as required for a complete and operational electrical system.

E. All 120V circuits shall have individual neutral conductors. 120V circuits with "shared" neutral conductor shall not be permitted.

F. Minimum wire size shall be #12 unless otherwise noted. Where protected by 15A fuses, control wiring may be #14 AWG.

G. All conductors shall be continuous without splices except at locations approved for the purposes of splicing.

H. All wire sizes shall be stranded except where specifically approved otherwise.

I. All circuits shall be labeled in compliance with Section 26 05 53 – Identification for Electrical Systems.

J. Pulling eyes on conductors or a basket weave grip shall be used for pulling cable. Woven wire cable grips shall be used to pull all single conductor cable where pulling eyes are not available. Preferred method for pulling conductors is factory-installed eyes attached to conductors. All sharp points and edges on the hardware attaching the pulling rope to the cable shall be taped to prevent snagging or damaging the raceway.

K. When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal plus 6 inches shall be cut off, and discarded when the pull is completed. When pulling loops are used, the entire loop shall be cut off and discarded when the pull is completed.

L. A non-binding type of swivel, or swivel connection shall be inserted between the pulling rope and the cable pulling eye, grip or loop to prevent twisting under strain and allow for free rotation of the cable during pulling.

M. The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both the manual and power types shall have the rated capacity clearly marked on the equipment. Cable shall be installed using either hand-tension or by use of specially-designed "cable-tuggers". Any cable pulled through conduit using trucks, back-hoe's, earthmoving equipment or similar apparatus will be rejected and will be replaced with new cable at the Contractor's expense.

N. Break-away shear-pins or other acceptable method of tension limitation shall be utilized on mechanical pulling equipment to prevent over-stressing cable during installation. To avoid insulation damage from excessive sidewall pressure at bends, the pulling tension, in pounds at a bend, shall not exceed 300 times the radius of the bend in feet.

O. As soon as the cable is pulled into place, the pulling eyes, cable grips, or pulling loops shall be removed. On exterior pulls, the remaining cable ends shall be temporarily resealed with either a minimum of three (3) wraps of 2" Scotch #23 rubber splicing tape or heat-shrink caps. Exposed cable ends shall be wrapped in such a manner to prevent unintentional water entry. Cable ends or seals shall be installed prior to the end of the workday.

P. Cable shall not be bent to a radius of less than 4 times the overall diameter, including installation apparatus.

Q. Cable supports and securing devices shall be installed to provide adequate support without deformation of the cable jackets or insulation.

R. Cables shall be routed within manholes and vaults such that adequate working space is provided within the structure for cable splicing and for the installation of future cables.

S. All damaged or rejected cable shall be removed from the project site and replaced at no additional expense to the project.

3.02 CONNECTIONS AND TERMINATIONS (WIRE CONDUCTORS)

A. Identify each conductor in panelboards, junction or pull boxes, or troughs with a permanent pressure sensitive label with suitable numbers or letters for easy recognition. Identify control wiring at each end and in junction boxes with numeric wire number corresponding to control wiring diagram.

B. Thoroughly clean wire before installing lugs and connectors.

C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

D. Terminate spare conductors with electrical tape, identify as “spares” and roll up in box.

3.03 TESTING (WIRE CONDUCTORS)

A. Inspect wiring for physical damage and proper connection.

B. All wire and cable shall be tested for continuity and short circuits prior to energizing circuits. Verify proper phasing, adjust as required.

C. CAT 6 Cable: Shall be tested in permanent link configuration. Testing shall be accomplished with a Level III test set with a minimum spectral frequency range of 1 to 250MHz. The test specifications for all installed cables must meet or exceed the specifications for CAT 6 cabling that are documented within the TIA/EIA- 568-C.1/2. Correct malfunctioning cables and retest to demonstrate compliance; otherwise remove and replace with new and retest. Typed or printed documentation must be provided listing all runs by location. The documentation must include the original instrument printouts detailing the results of all the tests. The documentation must also detail the date each cable was tested and the tester's name.

D. Comply with all applicable items in Section 26 01 26 and 26 05 00.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.02 Work under this item includes the electrical grounding and bonding of the service entrance gear, electrical distribution equipment, metallic raceways, metallic enclosures, utilization equipment and other appurtenances for the work or equipment to be furnished under this project. In general, all work shall meet or exceed that defined in article 250 of the national electrical code NEC/NFPA 70.

1.03 This specifications section neither replaces any NEC requirements, nor are any NEC requirements not specifically identified considered deleted from the scope of work. Items listed in this section are furnished to either augment or exceed those established by NEC.

1.04 SUMMARY

A. Equipment grounding conductors

B. Grounding Electrodes

C. Grounding Electrode Conductors

D. Bonding

E. Related Sections
   1. Section 26 05 00 – Common Work Results for Electrical
   2. Section 26 43 13 – Surge Protective Devices for Low Voltage Power Circuits

F. Reference to Standards
   1. Article 250; ANSI/NFPA 70 - National Electrical Code (NEC)
   2. NFPA 780 – Standard for the Installation of Lightning Protection Systems

1.05 SUBMITTALS

A. Submit under provisions of Division 01.
   1. Ground rods
   2. Exothermic welding components

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE (RESERVED)

1.08 DELIVERY, STORAGE AND HANDLING

A. Ground rods shall be tie-wrapped together and stored away from contact with the earth.

B. Exothermic welds and hardware items shall not be shipped loose but shall be in boxes, labeled with material and equipment enclosed. Boxes shall be stored away from contact with earth and shall be protected from weather.

1.09 REGULATORY REQUIREMENTS (RESERVED)

1.10 COORDINATION

A. Installation of all Grounding and Bonding shall be coordinated with other trades and Sub-Contractors. Special attention is required for installation of Concrete-Encased Electrodes within structural footings.

1.11 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.12 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (RESERVED)

2.02 EQUIPMENT SPECIFICATION

A. Ground rods shall be UL listed, single-piece, 3/4" diameter by 10' long copper-clad steel with minimum 10 mil copper cladding.

All buried connections of grounding and bonding components shall be via exothermic weld only. Clamp or compression grounding connections below grade will be rejected and replaced at Contractor's expense.

B. Exothermic Welding Equipment Manufacturers
1. Erico – Cadweld
2. Continental Industries – Therm-O-Weld
3. Hagar – Ultraweld

C. Grounding conductors shall be 600 volt, same insulation type as used for phase conductors, green in color unless otherwise noted.

D. Grounding electrode conductors in contact to earth shall be bare, stranded, annealed copper. Grounding Electrode Conductors shall be the larger of that detailed on the project drawings, specified herein or as required by NEC.

PART 3 EXECUTION

3.01 EXAMINATION (RESERVED)

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. A continuous grounding system shall be provided throughout the facility. The Contractor shall furnish and install all grounding and bonding as required per NEC and all Local Codes, whether or not specifically shown on the project drawings.

B. Except for separately derived systems, a single-point ground system is intended throughout the facility. So-called "Multi-point", "independent", "clean" or "separate" grounding systems that are not inter-bonded to the single-point facility system do not comply with NEC, are unsafe, and will be rejected.

1. On occasion, supplemental driven ground rods may be required on the project drawings. All such supplemental ground rods are to be bonded to the equipment grounding conductor and are NOT intended to indicate any separation of, or isolation from, the facility grounding system.

C. Equipment ground conductors (green insulated) shall be used solely for grounding and bonding purposes and be kept entirely separate from grounded neutral conductors (white insulation), except where bonded at the Service Entrance equipment.

1. The system Neutral and Ground conductors shall be bonded together through the Main Bonding Jumper in the Service Entrance Equipment only.
2. Unless otherwise directed on the project drawings, Grounding Electrode Conductors shall terminate on the Neutral Bus within the Service Entrance equipment.
3. The Main Bonding Jumper within the Service Entrance equipment shall be accessible for visual inspection.

D. All metallic raceways, boxes, enclosures, etc. shall include an insulated equipment ground conductor. Due to corrosion, metallic raceway and conduit connectors alone WILL NOT be considered as meeting this requirement. The Equipment Grounding Conductor shall positively bond all electrical components and utilization equipment to the facility ground system.

E. All metallic boxes used for electrical equipment shall include listed grounding screws or lugs. No more than one grounding conductor shall be installed per lug location unless lug is listed for multiple conductors.

F. The largest factory-scored concentric conduit knockouts shall be used to provide conduit bonding to NEMA 1 & 3R enclosures.

1. If required, provide a conduit reducing hub for the specific conduit size terminated.

G. Equipment Grounding Conductors shall be sizes as shown in NEC T250.122, but no less than #12 AWG.

H. All other exposed metal piping (e.g. air, fire-protection, natural gas, metallic process piping etc.) and exposed structural steel not used as a Grounding Electrode shall be bonded to the Grounding Electrode System per NEC Article 250.104. Size of the copper bonding jumper shall be no smaller than that shown in NEC Table T250.66.

I. All communications systems described in NEC Chapter 8 shall be bonded to system ground. Installation shall comply with NEC Article 250.94 and Articles 800, 810, 820 and 830. Size of the copper bonding jumper shall be #6 AWG unless otherwise noted on the project drawings.

3.04 MANUFACTURER'S FIELD SERVICES (RESERVED)

3.05 TESTING

A. As described in Specifications Section 26 01 26.

B. All grounded metal cases and parts associated with electrical equipment shall be tested for continuity with ground system.

C. If requested, testing shall be performed in the presence of the Owner's representative.

D. Provide a copy of all testing reports to Engineer for record purposes.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Strut-type framing for conduit and equipment supports

B. Cable Rack saddle-type supports

C. Anchors and Fasteners

D. Related Sections
   1. Section 26 05 00 – Common Work Results for Electrical

E. Reference to Standards
   1. ANSI/NFPA 70 - National Electrical Code.
   2. NECA - National Electrical Contractors Association.
   3. ASTM No. A570 G33
   4. ASTM No. A-123
   5. ASTM No. A-525
   6. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.03 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide manufacturer's catalog data for fastening systems and supports.

C. Manufacturer's instructions: Include application conditions and limitations for use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination and installation of Product.

1.04 QUALIFICATIONS (RESERVED)

1.05 QUALITY ASSURANCE (RESERVED)

1.06 DELIVERY, STORAGE AND HANDLING

A. Stored conduit and equipment supports shall not be in contact with earth, but shall be on pallets or other above-grade supports. Conduit and equipment supports shall be covered to minimize exposure to weather.

B. Anchors and fasteners shall be stored in their original containers in a clean, dry place. They shall not be exposed to weather.

1.07 COORDINATION (RESERVED)

1.08 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.09 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MOUNTING STRUT

A. Where utilized, strut-type metal framing shall be provided to mount and support electrical equipment and enclosures as indicated on the drawings.

B. Strut-type supports shall be cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

C. Metal Items for Use Outdoors or in Damp Locations: Hot dipped galvanized steel.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.\

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, pin Ends.

2.02 CABLE RACKS

A. Cable racks within manholes, handholes and vaults shall be non-metallic saddle type construction as manufactured by Underground Devices, Inc.; Northbrook, IL, or equivalent. All mounting hardware shall be stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine all supports and fasteners for straightness, rust and corrosion. Do not use any equipment that is not straight or is rusted or corroded.

3.02 PREPARATION

A. All equipment shall be clean at time of installation. Remove all burs.

3.03 INSTALLATION

A. Install products in conformance with manufacturer's instructions and as detailed in drawings.

B. Provide anchors, fasteners and supports in accordance with NECA Standard of Installation. Do not use spring steel clips or clamps except as noted in Section 26 05 29-3.03H.

C. Do not fasten supports to pipes (except where detailed on drawings), ducts, mechanical equipment (except where detailed on drawings), or conduit.

D. Install surface mounted cabinets, enclosures and panelboards with a minimum of four anchors.

E. Provide materials, sizes and types of anchors, fasteners, and supports necessary to carry loads of equipment and conduits. Consider weights of equipment and conduit when selecting products.

F. Provide all necessary hardware, such as floor flanges, in order to install equipment as specified or as shown on the drawings.

G. Include knee-braces and stiffeners as necessary to provide rigid support such that equipment does not bounce or sway.

H. Use spring-lock washers under all nuts.

3.04 INTERFACE WITH OTHER PRODUCTS (RESERVED)

3.05 MANUFACTURER'S FIELD SERVICES (RESERVED)

END OF SECTION 26 05 29

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Work included in this section is conduits, raceways and fittings required for operation and maintenance of facility.

B. Related Sections

1. Division 11 – Equipment
2. Section 26 05 00 – Common Work Results for Electrical
3. Section 26 05 19 – Low Voltage Conductors and Cable
4. Section 26 05 29 – Hangers and Supports for Electrical Systems

C. Reference to Standards

1. Federal Specifications WW-C-581d
2. Federal Specifications WW-C-540c
3. Federal Specifications WC-1094-A
4. ANSI C80.1
5. ANSI C80.3
6. ANSI C80.5
7. ANSI/NEMA OS-1 – Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports
8. UL 50 – Enclosures for Electrical Equipment
9. UL Standard UL-1 Standard for Flexible Metal Conduit
10. UL Standard UL-6 Electrical Rigid Metal Conduit – Steel
11. UL Standard UL-6A Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless Steel
12. UL Standard UL-651 Standard for Schedule 40, 80, Type EB and a Rigid PVC Conduit and Fittings.
13. UL Standard UL-651A Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit.
14. UL Standard UL-797 Electrical Metallic Tubing - Steel
15. UL Standard UL-1479 Standard for Fire Tests of Penetration Firestops.
16. NEMA RN1

17. NEMA RN2
18. NFPA 70 (NEC)
19. NEMA TC-2
20. NEMA TC-3
21. NEMA TC-7
22. NEMA 250

1.03 SUBMITTALS (SUBMIT ONLY ON TYPES APPLICABLE FOR PROJECT)

A. Submit under provisions of Division 01.

B. Schedule 40 Galvanized Rigid Steel Conduit

C. PVC Coated Galvanized Rigid Steel Conduit

D. Schedule 40 Aluminum Rigid Conduit

E. Electrical Metallic Tubing (EMT)

F. Rigid PVC Conduit

G. Flexible Metal Conduit

H. Liquid Tight Flexible Metal Conduit

I. Explosion-proof Flexible Metal Couplings

J. High-Density Polyethylene Conduit (Unit Duct)

K. Fittings and Conduit Bodies

L. Expansion/Deflection Fittings

M. Lay-In Wireway

N. Conduit Seals
   1. Conduit Fire Stopping
   2. Conduit Water Seals
   3. Conduit Explosion Proof Seals

1.04 QUALIFICATIONS

A. All materials shall be purchased new from suppliers/manufacturers regularly engaged in the business of electrical conduit, ducts and fittings.

B. Junction and pull boxes shall be manufactured and supplied by a company regularly engaged in business of furnishing junction and pull boxes. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of five years in manufacture of junction and pull boxes. Junction and pull boxes shall be U.L. listed.

1.05 DELIVERY, STORAGE AND HANDLING

A. Conduits shall not be shipped loose, but shall be bundled by sizes. Threads of metal conduits shall be protected by plastic caps. Fittings shall be stored in boxes. All equipment shall be stored on pallets to prevent contact with earth and shall be covered with plastic sheeting to protect them from dirt and weather.

B. Junction and pull boxes shall not be shipped loose, but shall be in boxes with labels indicating size and type. These boxes shall be stored away from contact with earth and protected from weather and abuse.

1.06 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

Note that all types specified below may not be used on every project. Refer to project drawings for individual project requirements.

A. Schedule 40 Galvanized Rigid Steel Conduit:

Conduit shall be of heavy wall type fabricated from mild steel tubing and shall have a hot-dipped galvanized inner and outer coating, with a final coating of zinc chromate. Conduit and installation shall comply with all requirements in NEC Article 344. Mounting hardware shall be corrosion resistant, stainless steel, or galvanized steel.

B. Schedule 40 Rigid Aluminum Conduit

Conduit shall be of 6063 aluminum alloy, T-1 temper (Former designation T-42). Rigid aluminum conduit shall be third-party listed for use in classified (hazardous) locations. Conduit and installation shall comply with all requirements in NEC Article 344. Do not utilize steel or iron conduit fittings with aluminum conduit. Mounting hardware shall be corrosion resistant: stainless steel or aluminum.

C. Electrical Metallic Tubing (EMT)

EMT shall be hot dip galvanized steel with an organic corrosion resistant coating and shall be produced in accordance with U.L. Standard 797, ANSI C80.3 and NEMA RN2. Fittings for EMT conduit shall be compression type only, set-screw type fittings shall not be utilized. Conduit and installation shall comply with all requirements in NEC Article 358.Mounting hardware shall be corrosion resistant: zinc, galvanized steel, aluminum or stainless steel.

D. Flexible Metal Conduit

Flexible metal conduit (Greenfield) shall consist of interlocking steel armor and shall comply with U.L. Standard 1 and 1479. Conduit and installation shall comply with all requirements in NEC Article 348.

E. Fittings and Conduit Bodies:

Unless otherwise specified, all fittings and conduit bodies shall be manufactured from the same type of material as the conduit system (aluminum, galvanized steel, PVC, etc.)

Field Modifications to Existing Rigid Metal Conduit Systems ONLY: Where modifications to existing rigid conduit installations make threading of field cuts impossible, use Type HK series couplings by Thomas & Betts/Steel City, or equivalent.

F. Expansion and Deflection Fittings

Where noted on project drawings, or required by the nature of construction location, furnish conduit Expansion, Deflection or Expansion/Deflection Fittings. Expansion and deflection fittings shall be compatible with other conduit materials and be type AX (expansion), DX (deflection) or AXDX (expansion/deflection) as manufactured by O-Z/Gedney, or equivalent.

G. Pull Cords

Each empty conduit shown or described on the drawings shall be furnished with a pull cord to facilitate future conductor installation. Cord shall consist of non-deteriorating, non-metallic, non-cotton construction such as polyester or nylon material. Minimum tensile strength of all pull strings shall be 200#. Leave minimum of 12 inches slack at each termination or end. Any references on project drawings to “pull wire” shall be interpreted as a pull cord as described herein.

2.02 SEALING

A. Fire Seal (Fire Stopping Material):

1. Fire stopping materials shall consist of commercially manufactured products capable of passing ASTM E-814 (UL 1479) Standard Method of Fire Test for Through Penetration Fire Stops.
2. Fire stopping materials shall maintain the rating of the wall, partition, ceiling or floor opening where penetration is made. Comply with NEC 300-21.
3. All fire-stopping materials shall be third-party classified.

4. Where sleeves are to be installed, the sleeve shall be heavy wall steel pipe sleeves, anchored to building construction and finished plumb with wall, ceiling, or floor lines.
5. Manufacturers:
   a. Chase Technology – CTC, PR-855.
   b. Dow Corning – Silicone RTV Foam 3-6548.
   c. Nelson – Flameseal.
   d. Thomas & Betts – Flame Safe.
   e. 3M – Fire Barrier.
6. Where applicable for the respective wall and its fire rating, smoke and fire stop fittings may be used in lieu of sealant as manufactured by OZ/Gedney, Series CFS.

B. Thermal Seal:
1. Seal penetrations of thermally insulated equipment or rooms top prevent heat transfer.

C. Moisture Seal:
1. When electrical conduits are installed in sleeves, core-drilled holes or box outs, seal between conduit and penetration of perimeter walls, ceilings or floors to prevent entry of water.
2. Seal conduit penetrations of roof with flashings compatible with roof design and approved by Roofing System Manufacturer and Engineer.
3. Seal annular space between conductors and conduit wall of all conduit terminations where conduit enters a building from below grade in order to block moisture migration into electrical equipment. In addition seal conduits entering electrical equipment located either interior or exterior that once installed condensation is created in the electrical equipment due the electrical system being connected to areas with a different temperature. Conduit moisture barrier material shall not harden and be compatible with both wire insulation and conduit materials. Installed product shall be easily removed for maintenance or modifications, regardless of the length of time material has been installed. Conduit moisture seal material shall be:
   a. "Hydroblock" by WaterGuard Technology Products
      16023 East Freeway
      Channelview, Texas 77530-4365
      Phone: (281) 862-0300
      Fax: (281) 862-0314

   b. American Polywater Corporation
      Polywater Duct Sealant FST-250 Series
      P.O. Box 53
      Stillwater, MN 55082
      Phone: (651) 430-2270
      Fax: (651) 430-3634

c. O-Z/Gedney
Type DUX Water Sealing Compound

2.03 BOXES

A. Dimensions of all boxes shall meet or exceed NEC Article 370 requirements. Boxes larger than 12 inches in any dimension shall be hinged type.

B. Flush mounted exterior boxes in floors, walkways and walls shall be NEMA 4, cast aluminum, Crouse Hinds, Killark, or equal. For supplemental corrosion protection, boxes encased in poured concrete shall have an asphalt paint coating applied to surfaces in contact with concrete prior to installation. Note that an asphalt paint coating is not required on boxes installed in masonry brick or block walls.

C. Surface mounted interior junction and pull boxes used with Schedule 40 PVC conduit shall be nonmetallic and shall be as manufactured by Carlon, or equal.

D. Surface mounted interior junction and pull boxes used with GRS or EMT conduit shall be NEMA OS-1, stamped galvanized steel.

E. Flush mounted interior boxes in concrete floors and concrete walls shall be NEMA 4, cast aluminum, Crouse Hinds, Killark, or equal, and shall be supplied with asphalt paint applied to all surfaces in contact with concrete.

F. Boxes used to support light fixtures shall be of metallic construction and capable of supporting installed fixtures.

G. Exterior junction and pull boxes located in non-hazardous, non-classified areas shall be NEMA 4X stainless steel or aluminum. Provide waterproof conduit hubs, Meyers or equivalent, for all conduit terminations at enclosures. Gasketed lock-nuts will not meet this requirement.

H. Acceptable manufacturers:
1. Appleton Electric Co.
2. Carlon
3. Crouse-Hinds Co.
4. Hammond
5. Hennessy Outdoor Enclosures.
6. Hoffman Co.
7. Hubbell-Killark Electric Mfg. Co.
8. O.Z./Gedney Co.
9. Square D.
10. Thomas & Betts

PART 3 EXECUTION

3.01 INSPECTION

A. All conduits shall be inspected for proper fit and finish, for out-of-round and for proper thickness. All burrs and flashing shall be removed. Conduit and fittings shall be clean and free of obstructions.

3.02 INSTALLATION

A. Unless otherwise specified or detailed on the project drawings, all wire and cable shall be installed in conduit.

B. Unless otherwise shown on the project drawings, minimum conduit trade-size shall be 3/4". Larger sizes shall be installed where noted or where required by NEC.

C. In general, no aluminum conduit shall be cast in concrete or in direct contact with earth. Where such contact is found necessary or where specifically noted on project drawings, either coat all aluminum contact surfaces with a protective bituminous coating (such as Carboline Bitumastic 50 or 300M) or alternately substitute galvanized rigid steel conduit for the sections which are in contact with concrete or earth.

D. Interior Conduit Applications:

1. Above Grade or Floor:
   In finished spaces: EMT
   In unfinished spaces: GRSC or Rigid aluminum type.
2. Below Grade or Floor:
   NA

E. Exterior Conduit Applications

1. Above Grade:
   GRSC or Rigid aluminum type unless otherwise noted on the project drawings. Where conduits exit to above grade transition to conduit type shall be no more than 6” from penetration.
2. Below Grade:
   GRSC

F. Moisture Seal of Below-Grade Conduits

1. Seal annular space between conductors and conduit wall of all conduit terminations where conduit enters from below grade in order to block moisture migration into electrical equipment. Install product only after conductors have been installed, terminated and commissioned for service. Install moisture seal products per all manufacturers instructions and requirements.

G. Conduit Sealing For Fireproofing

1. Sleeves:

a. Install rigid metallic sleeves where exposed raceways pass through floors, walls (except exterior walls below grade) and ceilings.
b. Sleeve Diameter: Size sleeves to accommodate their through penetrating items and allow a minimum of a one (1") inch void between the sleeve and the item of penetration.

2. Seal openings in fire rated floors, ceilings and roofs:
a. Pack void with backing material and ends of the sleeve sealed with a minimum of one (1") inch of a listed fire-resistive silicone compound to a depth required to meet the fire rating of the structure penetrated.
b. Install firestopping to meet the requirements of ASTM E-814
c. Install product in accordance with the manufacturer's instructions.

H. Conduit size and fill requirements shall comply with appropriate conduit fill tables in Annex C of NEC. It should be noted these are minimum requirements and larger conduit sizes or smaller fill requirements shall be used whenever specified or detailed on drawings.

I. Flexible conduit shall be provided as a connection between each motor junction box (or any other piece of equipment subject to movement or vibration) and rigid conduit system. Liquid-tight and explosion-proof flexible conduit shall not exceed 3' in length.

J. Ream conduits only after threads are cut. Cut joints square to butt solidly into couplings. Where necessary to join two pieces of conduit and it is impossible to use standard coupling, use three piece conduit coupling. Use of running thread is prohibited. This applies to all rigid conduit installations, underground or otherwise. In order to comply with NEC Article 300.6(A), all rigid steel conduit shall have field-cut threads re-coated using an electrically conductive, corrosion-resistant compound, Thomas & Betts/Shamrock "Kopr-Shield" (a product of Jet Lube, Inc.), or equivalent.

K. Make all joints in underground conduit watertight with approved joint compound. Temporarily plug conduit openings to exclude water, concrete or any foreign materials during construction. Clean conduit runs before pulling in conductors.

L. Hickey hand-bends will not be acceptable for conduits one inch (1") and larger. Use pre-manufactured factory elbows or bends fabricated with hydraulic bending machine. Field bending of all PVC conduit shall be accomplished with use of equipment approved by conduit manufacturer. Open flame bending equipment will not be acceptable.

M. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of four quarter turn bends (360°), including bends immediately at an outlet or fitting.

N. At all conduit terminations furnish locknuts on both sides of enclosure plus an insulated bushing unless conduit termination is into a factory-threaded conduit opening or watertight (Myers-type) hub.

O. All conduit terminations at NEMA 4 or 4X enclosures shall be made with watertight (Myers-type) hubs listed for the application.

P. Do not run conduit below or adjacent to water piping, except where permitted by Owner's representative.

Q. Run exposed conduits parallel with walls and at right angles to building lines, not diagonally.

R. Support exposed PVC conduit runs on walls or ceiling every three feet (3') and support exposed rigid metal conduit runs on walls or ceiling every five feet (5') with stainless steel or PVC coated galvanized cast one hole straps, clamp backs and anchors. Provide lead shield insert anchors, with stainless steel round head machine screws, for concrete and brick construction. In wood construction, use stainless steel round head wood screws. Where steel members occur, drill and tap and use stainless steel round head machine screws.

S. In brick construction, drill hole for insert near center of brick, not near edge or in mortar joint.

T. Support two or more PVC exposed hanging parallel conduit runs every three feet (3') and support exposed rigid metal hanging parallel conduit runs every five feet (5') with trapeze hangers. Hanger assembly to consist of concrete inserts, threaded solid rod, washers, nuts and cross members nominally one and five-eighths inch (1-5/8") by one and five-eighths inch (1-5/8") non-metallic framing, as specified in Section 26 05 29 – Hangers and Supports for Electrical Systems. Anchor each conduit individually to cross members of every other hanger with cast one hole straps, clamps backs and proper sized stainless steel or non-metallic machine bolts and nuts.

U. Perforated metal strapping of any kind is prohibited.

V. Provide expansion and deflection fittings in all conduits which pass through or over building expansion joints. All expansion and deflection fittings shall be designed for, and compatible with, the conduit types on which they are installed.

W. Grounding Electrode Conductors shall be installed in non-metallic PVC conduit or bonded to both ends of metallic conduit to comply with NEC 250.64.

X. PVC coated galvanized rigid steel conduit shall be installed per manufacturer's requirements, using tools specifically designed for installation of PVC coated galvanized rigid steel conduit. Any tools, hardware or installation methods which cause damage the PVC coating shall not be utilized. Do not install any material found damaged from shipping or handling. Any PVC coated conduit damaged during installation shall be immediately repaired to the satisfaction of the Owner's authorized representative using patching materials and methods per manufacturer's instructions. If, in the opinion of the Owner's authorized representative, PVC coated galvanized rigid steel conduit is damaged beyond repair, the damaged portion(s) shall be removed and replaced at the contractor's expense.

3.03 BOXES INSTALLATION

A. Junction or pull boxes required by code or need which are not detailed on drawings shall be considered incidental to proposal price and will not be paid for separately.

B. Any damage to equipment enclosures, pull or junction boxes shall be immediately repaired or replaced to satisfaction of Owner's representative.

C. All pull or junction boxes surface mounted in any interior damp location shall be "standoff" mounted 1/2" from the wall in a manner to promote air circulation completely around the box.

D. The contractor shall coordinate the installation of flush mounted junction boxes with the general and mechanical work as required at each structure.

E. Flush mounted junction boxes to be installed in precast top slabs shall be furnished by the contractor for installation, and shall be furnished completely assembled, including conduit nipples and stub-outs with ends covered by protective caps.

F. Provide knockout closures to cap unused knockout holes where blanks have been removed (for non-hazardous location boxes).

G. All mounting hardware shall be corrosion resistant.

H. All metal junction boxes shall be bonded to ground with a ground wire connection.

END OF SECTION 26 05 33

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes field-installed nameplates, labeling and identification methods for electrical equipment, components and wiring.

B. Related Sections

1. Section 26 05 00 – Common Work Results for Electrical

C. Reference to Standards

1. ANSI/NFPA 70 - National Electrical Code

1.03 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Provide catalog data for nameplates, labels and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

D. During course of construction, Contractor shall submit Wiring Identification Tables, listing wire marker identification schedules of all proposed wiring and terminations.

1.04 QUALIFICATIONS (RESERVED)

1.05 QUALITY ASSURANCE (RESERVED)

1.06 DELIVERY, STORAGE AND HANDLING

1.07 COORDINATION (RESERVED)

1.08 MAINTENANCE SERVICE (WARRANTY) (RESERVED)

1.09 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (RESERVED)

2.02 EQUIPMENT SPECIFICATION

A. Nameplates and legend plates shall be engraved three-layer laminated plastic, black letters on white background. Legends (wording) shall be as detailed on drawings or as directed by Owner's representative.

B. Arc Flash labels shall be polyester type that are waterproof.

C. All wire markers installed on electrical equipment above grade shall be weatherproof and water resistant. Wire identification labeling, whether factory applied or written in the field, shall utilize an adhesive that does not soften or weaken over time. Sleeve or tubing type labels may be utilized as an alternate. Paper adhesive-backed wire markers will be rejected and replaced at the Contractor's expense. Wire marker labels shall be as manufactured by Brady, or equivalent.

D. All wire markers installed below grade in manholes, handholes or vaults shall be waterproof. Markers shall be non-corroding plastic clip-on sleeve type construction. Markers shall be permanently factory-printed such that label identification will not deteriorate due to time or contact with water. Wire markers used below grade shall be Brady Clip-Sleeve, or equivalent.

E. Provide and install Safety Stripe Tapes on finished floors around electrical gear noting clearances required per NEC Article 110.26. Tape shall be minimum 2" in width with alternating black/yellow striping. Tape shall be Scotch/3M #5702 or equivalent.

PART 3 EXECUTION

3.01 EXAMINATION (RESERVED)

3.02 PREPARATION

A. Degrease and clean surfaces to receive nameplates, legend plates and markers.

3.03 INSTALLATION

A. Secure nameplates and legend plates to equipment using screws or adhesive.

B. Nameplates or legend plates shall be provided for all disconnects, enclosed starters, control panels, transformers, level meters, flow meters and recorders.

C. Per NEC 110.16: Arc Flash warning labels shall be included for all electrical equipment, such as switchboards, switchgear, panelboards, industrial control panels, meter socket enclosures and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized. Labels shall

be field or factory marked to warn qualified persons of potential electric arc flash hazards. Label shall be permanently affixed, able to withstand the environment involved and shall not be hand written.

D. Per NEC 408.4 (B) All switchboards, switchgear and panelboards supplied by a feeder shall be permanently marked to indicate which device or equipment where the power originates. Label shall be self-adhesive, polyester type waterproof and shall not be handwritten.

E. Wiring Device identification labels shall be furnished and installed on all wiring device cover plates per Specifications Sections 26 27 26-3.01O and 26 27 26-3.01P.

F. Contractor shall develop the Wiring Identification Tables to be used for ALL wiring terminations on this project, and shall submit Tables for review and comment by Owner's Representative prior to installation of any conductors or cables.

G. Provide wire markers for ALL wires and terminations. By "all", this is intended to include, but not be limited to, all terminations at distribution panelboards, motors, valves, heaters, fan coils, heat pumps, fans, dampers, all MCC terminations, instrumentation & controls, terminal blocks and strips, etc. Wire identification shall be unique to wire that is marked or to terminal that wire lands upon. Identification of a run of wire from termination to termination shall be same throughout run.

H. Provide wire markers in all manholes, handholes and vaults.

I. Include markers labeled "SP" on all spare conductors.

3.04 INTERFACE WITH OTHER PRODUCTS (RESERVED)

3.05 MANUFACTURER'S FIELD SERVICES (RESERVED)

3.06 AS-BUILT WIRING IDENTIFICATION TABLE

A. Upon completion of project, Contractor shall provide five copies of as-built Wiring Identification Table. This table shall list all circuits installed as part of this work and shall give identification of all wires and terminations as installed and marked.

Table shall include routing of all conductors installed in the project from end-to-end including each conduit, manhole, handhole and vault through which each conductor passes. Include and identify all spare conductors.

END OF SECTION 26 05 53

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Work in this section is supply and installation of receptacles and toggle switches.

B. Work shall also include supply and installation of device boxes for receptacles and toggle switches.

C. Work shall also include supply and installation of remote control pushbutton stations.

D. Work shall also include supply and installation of multi-outlet surface mounted raceway (where required).

E. Related Sections

1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 19 – Low-Voltage Conductors and Cables
3. Section 26 05 33 – Raceway and Boxes for Electrical Systems
4. Section 26 05 53 – Identification for Electrical Systems

F. REFERENCE TO STANDARDS

1. UL Standard 943 Class A
2. Federal Specification W-C-596F
3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
4. NEC Article 410-57
5. NEMA WD-1
6. NEMA WD-6
7. ANSI/NEMA OS-1 - Sheet Steel Outlet boxes, Device Boxes, Covers and Box Supports
8. U.L. 514A - Metallic Outlet Boxes
9. U.L. 498

1.03 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Division 01.

1. Receptacles

2. Toggle switches
3. Weatherproof covers and device boxes
4. Remote control stations
5. Multi-outlet raceway (if used)

B. Where applicable, color of wiring devices to be identified during submittal review.

1.04 QUALIFICATIONS

A. Wiring devices shall be manufactured and supplied by companies regularly engaged in business of furnishing wiring devices. If required by Owner's representative, manufacturers shall submit certification to a minimum experience of five years in manufacture of respective wiring devices.

1.05 DELIVERY, STORAGE AND HANDLING

A. Supplied items shall not be shipped loose but shall be in boxes, labeled with material and equipment enclosed. Boxes shall be stored away from contact with earth and shall be protected from weather.

1.06 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. Receptacles:
1. Receptacles shall be installed under this item where shown on drawings.
2. General Purpose Receptacles (Non-GFCI)

General purpose receptacles for all wall type convenience outlets in non-hazardous areas shall be of 20-amp, 125-volt, 3-wire grounding type, NEMA 5-20R, back and side wire compatible, heavy duty industrial specification grade. Verify color during shop drawing review.
a. Leviton 5362-W
b. Pass & Seymour 5362-AW
c. Hubbell HBL5362-W
d. Equivalent

B. Self-Test Ground Fault Circuit Interrupting (GFCI) Duplex Receptacles

1. Duplex receptacles with ground fault circuit interrupters (GFCI) shall be provided and installed where noted on drawings. Receptacle shall be tamper resistant. Include indicator light that is lighted when device is tripped. Self-test feature to conduct an automatic test, ensuring ground protection. If ground fault protection is comprised, power to the receptacle must be discontinued. Verify color during shop drawing review. GFCI Receptacles shall be of the following types:

   a. Interior GFCI Applications (Non-Hazardous)
      i. Leviton "SmartLock Pro) GFNT2-X
      ii. Pass & Seymour 2097
      iii. Hubbell GFTRST20
      iv. Equivalent, meeting requirements noted.

   b. Weather-Resistant, Self-Test GFCI Receptacles.

2. Where indicated on the drawings, UL Weather-Resistant GFCI receptacles in non-hazardous areas shall be 20-amp, 125-volts, 3-wire grounding type, NEMA 5-20R, back and side wire compatible, specification grade. Include indicator light that is lighted when device is tripped. Self-test feature to conduct an automatic test every three seconds, ensuring ground protection. If ground fault protection is comprised, power to the receptacle must be discontinued.

   i. Leviton GFWT2
      ii. Pass & Seymour 2097WR
      iii. Hubbell GFWRST
      iv. Equivalent

C. Special Purpose Receptacles (Where Required)

1. Special purpose receptacles shall have amperage, voltage, number of poles, number of wires as required or as shown on drawings. Contractor shall verify compatibility between proposed special purpose receptacles and plugs of proposed equipment prior to ordering. Contractor shall also provide labels for special purpose receptacles.

D. Toggle Switches

1. Toggle switches shall be installed under this item.
2. General Purpose Toggle Switches

Units for use in non-hazardous, toggle-type applications shall be 20A, 120/277 VAC rated, back and side wired type, industrial specification grade. Switches shall be duty rated for 1 HP at 120 VAC. Verify color during shop drawing review.

a. Single Pole
Leviton 1221-2
Pass & Seymour CSB20AC1
Hubbell HBL1221
Equivalent

b. Three-Way
Leviton 1223-2
Pass & Seymour CBS20AC3
Hubbell HBL1223
Equivalent

E. Unless noted otherwise on the drawings, wall plates shall be of stainless steel.

F. Weatherproof Receptacle Covers

1. All receptacle covers noted as "weatherproof" with the letters “WP” or installed outdoors shall comply with NEC Article 406.9B1. Units shall remain raintight whether or not a plug and cord is inserted. Covers shall be extra-deep, padlock able, cast aluminum construction, listed and identified as “extra duty” as manufactured by Intermatic WP1010HMXD, Hubbell, WP26EH, Pass & Seymour CA26WVor equivalent, horizontal, for use with GFCI receptacles.

G. Device Boxes

1. Where PVC conduit is used, associated device boxes shall be of FS design, non-metallic PVC, as manufactured by Carlon, or equivalent.
2. Where galvanized rigid metal conduit is used, associated device boxes shall be FS or FD design, metallic, as manufactured by Crouse-Hinds, or equivalent.

H. CONTROL STATIONS

1.

a. Pushbutton type control stations used to control motors, solenoids and selected lights and heaters, etc., shall be furnished and installed under this item and located where indicated on drawings.

2. General Purpose Control Statins (Non-Hazardous Locations)

Interior and exterior general-purpose control stations shall be NEMA 4X rated, with NEMA 4X enclosures. Selector switches, pushbuttons and transformer type, push-to-test indicating lights shall be Square D Type SK, or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified on the drawings, use the following as a guide for mounting of device boxes and control operator (pushbutton) stations:

	Device	Height above finished floor to bottom of box
1.	Receptacles in offices and finished areas.	16 inches
2.	Toggle wall switches	48 inches
3.	Receptacles in all other or non-finished areas.	48 inches
4.	Receptacles near sinks	48
5.	Data Outlets	16 inches
6.	Fire Alarm Break Glass Stations	44 inches
7.	Fire Alarm Horns/Lights	96 inches
8.	Control Operator (P.B.) Stations	48 inches

B. Unless otherwise noted on the drawings, boxes for wiring devices shall be flush mount construction such that device cover plates are flush with wall after installation.

C. Legend plates shall be securely attached using weatherproof adhesives in accordance with Section 26 05 53.

D. All receptacles and toggles switches shall be grounded with a ground conductor connected to their respective grounding terminal or screw.

E. Grounded conductors (neutrals) shall be continuous between outlets, boxes, devices, and so forth per NEC Article 300.13. Wiring device neutral connections shall not be utilized as splice points. Neutral path shall not be broken with wiring devices removed from boxes.

F. Test all receptacles, toggle switches and control stations for proper operation, including GFCI operation where applicable.

G. Modular devices are permitted for use. Modular connectors shall contain crimped and welded brass connections. Modular receptacles shall be listed to UL498, UL20, WC-596G, WC-896, Leviton Lev-Lok, Pass & Seymour PlugTail, or equal.

H. Ground device enclosure or box with a ground conductor connected to the respective grounding lug or screw.

I. Unless specifically shown otherwise on the drawings, all device boxes are to be flush mounted. This includes masonry construction.

J. Where boxes are to be installed in finished masonry walls, adjust position of outlets to suit masonry course lines.

K. Do not install boxes back-to-back in the same wall. Provide minimum 4 inches separation.

L. Provide insulation behind boxes mounted in exterior walls.

M. For boxes, outlets or multi-outlet raceway installed above counters or backsplashes, coordinate location and mounting height to agree with other trades and equipment.

N. Unless otherwise specified, install wall switches with "OFF" position down.

O. Unless otherwise specified, install duplex outlets with ground blade on the bottom if mounted vertically or to the right if mounted horizontally. Install GFCI receptacles in such that "Test" and "Reset" wording are oriented correctly.

P. Each duplex outlet cover shall be furnished with a 3/8"-1/2" adhesive label strip identifying its respective source of supply (e.g. LP1-15 for Lighting Panelboard LP-1 circuit #15). All labels shall be affixed to the exterior (outside) of each respective cover plate. All duplex outlet labels shall be installed in the same general location on each cover plate throughout the project.

Q. Each toggle wall switch shall be furnished with a 3/8"-1/2" adhesive label strip identifying its respective source of supply (e.g. LP1-16 for Lighting Panelboard LP-1 circuit #16). All toggle switch labels shall be affixed to the rear (inside) of the respective cover plate.

R. Exterior receptacles shall be mounted horizontal.

END OF SECTION 26 27 26

SECTION 26 50 00
INTERIOR LIGHTING

PART 1 GENERAL

1.01. WORK INCLUDES

A. Base Bid:
1. Electrical Contractor shall provide
a. Lighting fixtures and accessories complete as shown or implied on the Contract Documents

1.02 RELATED WORK

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

B. Specified Elsewhere
1. Section 26 01 26 – Testing Electrical Systems
2. Section 26 05 00 – Common Work Results for Electrical
3. Section 26 05 19 – Low-Voltage Conductors and Cables
4. Section 26 05 26 – Grounding and Bonding for Electrical Systems
5. Section 26 05 33 – Raceways and Boxes for Electrical systems
6. Section 26 05 53 – Identification for Electrical Systems
7. Section 26 09 23 – Lighting Controls
8. Section 26 27 26 – Wiring Devices

1.03 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the designation only:

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Submittals and Section 26 05 00 Common Work Results for Electrical.

B. Submit manufacturer's data on lighting fixtures, assembled by luminaire "type" the fixture schedule order, with the proposed fixture and accessories clearly labeled. Include photometric data. Ballast and lamp product data shall accompany fixture submittals.

C. In addition to the printed copies of the submittal, a portable document

format (pdf) of the submittal shall be transmitted via email to the Engineer.

D. Project information: Not required for Engineer/Architect review.
E. Contract closeout information: Not required for Engineer/Architect review.
   1. Operating and maintenance data.
   2. Owner instruction report.
   3. As Built Drawings

F. Warranties: Provide one (1) year minimum material and labor warranty on all components from date of substantial completion. Provide five (5) year manufacturer's warranty on all electronic ballasts. Provide three (3) year warranty on all led lamps and drivers.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 2011

B. Products: Listed by a Nationally Recognized Testing Laboratory and classified as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01. LIGHTING FIXTURES/MANUFACTURERS

A. Lighting fixtures shall be as per fixture schedule.
B. Acceptable Manufacturers: As shown on fixture schedules.

2.02. LIGHT FIXTURES

A. LIGHT EMITTING DIODE (LED) LIGHTING FIXTURES
   1. White LED fixtures for general illumination shall have been tested by the US Dept. of Energy's CALiPER program, IES LM-79 and LM-80.
   2. Color temperature: No greater than 5000K for indoor illumination. 3500 K strongly preferred.
   3. All LED luminaires shall have been designed around the LED source. LED lamps marketed as replacements for four foot fluorescent T8s shall never be used.
   4. LED systems shall be modular and allow for separate replacement of the LEDs and driver. "Throw-away" fixtures with non-replaceable components are not permitted.
   5. LED fixtures shall be equipped with wiring disconnect device to disconnect both line and neutral conductors to the LED driver.

6. Warranty: Minimum 3-year manufacturer warranty on LED lamps and drivers.

B. Other Lighting Fixtures:
   1. Incandescent ceiling recessed light fixtures shall be furnished complete with prewired junction box and trim rings; where not otherwise specified, trim rings shall be finished baked white enamel; such fixtures shall be listed and labeled as complying with thermal protection requirements of NEC.
   2. HID lighting fixtures shall be supplied complete with integral ballast, constant wattage secondary single-lamp type with minimum 90% power factor, 10% voltage/wattage regulation, outdoor units weatherproof and suitable for operation at -20°F; all HID fixtures shall have integral fuse protection.
   3. Where scheduled or required by fixture type, remote mounted HID ballast (long range igniter) wiring lengths shall not exceed the manufacturer's requirements. Wire size shall be per the manufacturer's requirements for the remote distance, #12 AWG minimum, unless otherwise scheduled or specified. The ballast shall be provided in a rated enclosure for the environment in which installed.
   4. Exit lights shall be end, back or canopy mounted as indicated or required, and shall be complete with directional arrows as required. For exit lights, the Electrical Contractor shall verify the lettering, lettering color, size, etc. of the specified units with local authorities and furnish lights, wiring and connections meeting the requirements of those authorities. Exit lights shall be equipped with self check feature.

C. Generator Transfer Device (Relay) shall be installed at fixtures designated. Generator Transfer device shall be Bodine GTD
   1. The device shall comply with UL 924 "Emergency Lighting and Power Equipment."
   2. The device shall transfer selected lighting fixture(s) to an alternate power source in the event of an interruption of the primary lighting power source.
   3. The device shall consist relay switching circuitry monitoring the primary power source and be capable of by-passing switch and powering lighting fixtures from the auxiliary source.
   4. Switching Capacity 3 A max at 120 or 277 Volts.
   5. Circuit burden of 280 ma. 1.6 watts during normal operation.

2.03 LAMPS

A. LED Lamps
   1. LED Lamps: self-contained replacement for 60 or 100 Watt A-19

incandescent lamps. for use in incandescent design fixtures

PART 3 EXECUTION

3.01. INSTALLATION

A. Quantities and Locations:
1. Lighting fixture locations shown on Contract Documents are for estimating purposes; final locations shall be in accordance with Engineer/Architect's reflected ceiling plan.
2. Furnish and install fixtures indicated by Contract Documents complete with lamps; provide an outlet for each such fixture.
3. Fixtures in mechanical rooms shall be located to clear piping, ductwork, valves, and other equipment and to illuminate panels, gauges, valves, controls, etc. These fixtures may be chain or stem hung and shall be so hung when required to illuminate the equipment noted.
4. Where different wattages of the same type of fixture are installed in the same room, all of the fixtures shall be of the same manufacturer.

B. Fixture Types:
1. Contractor shall verify ceiling construction with ceiling supplier prior to ordering fixtures and shall provide grid, flange, or surface mounted units where required.

C. Generator Transfer Device installed on fixtures designated.
1. Connect Transfer device to Alternate source.
2. Wiring of transfer device per manufacturer’s instructions.
3. Connect to Center lamp ballast in three lamp fixtures.
4. Connect to one ballast in two and four lamp fixtures.

D. Mounting:
1. Suspended fixtures shall be mounted approximately 8'-0" to bottom above finished floor unless otherwise noted on Contract Documents.
2. Install recessed fixture to permit removal from below.
3. Install clips to secure recessed grid-supported fixtures in place.
4. Bond fixtures and metal accessories to form a continuous path to ground.
5. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions.
6. Recessed fixtures installed in ceilings fire rated for one hour or more shall be provided with a one hour fire rated enclosure. Coordinate ceiling construction fire ratings with the Architectural plans and schedules.

E. Adjusting: Aim and adjust fixtures per directions of Engineer/Architect.

F. Cleaning:
   1. Clean electrical parts to remove dirt and debris.
   2. Clean photometric control surfaces.

END OF SECTION 26 50 00.

SECTION 31 22 13
ROUGH GRADING

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Excavate subsoil and stockpile for later reuse. Remove excess from site.

B. Grade and rough contour site improvement areas.

1.02 RELATED WORK

A. Specified Elsewhere:

1. All Sections of Division 31 and 32.

1.03 SUBMITTALS

A. Accurately record location of remaining, rerouted or new utilities by horizontal dimensions, elevations or inverts, and slope gradients on Contract Documents.

B. Submit test results of compaction testing – See Section 31 23 23 - Fill.

1.04 REFERENCES

A. Conform to the applicable portions of Sections 202 and 205 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.

1.05 PROTECTION

A. Protect existing trees, shrubs, lawns and other features remaining as portion of final landscaping.

B. Protect benchmarks, existing structures, fences, roads, sidewalks, paving, curbs and all other items to remain.

C. Protect above- or below-grade utilities which will remain.

D. Protect work from damage caused by settlement or movement caused by rough grading.

E. Repair damage.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Subsoil: Excavated material (other than topsoil) which is graded free of lumps larger than 6 inches, rocks larger than 3 inches and debris.

PART 3 – EXECUTION

3.01 PREPARATION

A. Identify specified lines, levels, contours and data.

B. Identify known below grade utilities. Stake and flag locations.

C. Identify and flag above grade utilities.

D. Maintain and protect existing utilities remaining which pass through work area.

E. Notify Utility Companies to remove and relocate necessary utilities.

F. Upon discovery of unknown utility or concealed conditions, discontinue affected work and notify the Engineer immediately. Confirm notification in writing.

G. Visit the site and become familiar with all existing conditions under which work is to be performed.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout or damage by rain or water accumulation.

C. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be re-landscaped or regraded and stockpile in area designated on site. Remove excess subsoil not being reused from Project site.

B. Excavate and remove all organic, loose or obviously compressive materials. The subgrade shall then be proof-rolled until the grade offers an unyielding surface and until the specified compaction is achieved; refer to Section 31 23 23 - Fill. Areas of excessive yielding shall be excavated and backfilled with clean, compacted soil that meets the approval of the Engineer.

C. Do not excavate wet subsoil.

D. Stockpile subsoil to depth not to exceed 4 feet.

E. When excavating through roots, perform work by hand and cut roots with a sharp axe.

3.04 TOLERANCES. Top surface of subgrade: Plus or minus 1 inch.

3.05 TESTING AND COMPACTION. Refer to Section 31 23 23 - Fill.

END OF SECTION 31 22 13

SECTION 31 23 16
EXCAVATION

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Excavating for sewers, pavements, sidewalks, curbs and gutter and incidental work.

B. Removal and off-site satisfactory disposal of unstable and unsuitable materials.

1.02 RELATED WORK (RESERVED)

1.03 REGULATORY REQUIREMENTS

A. Codes and Standards:

1. Conform to the applicable portions of Sections 202 and 502 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.
2. Prior to the commencement of construction, the Contractor shall be aware of, and become familiar with applicable local, state and federal safety regulations, including the current OSHA Occupational Safety and Health Standards - Excavations, 29 CFR Part 1926, including any successor regulations.
3. Additionally, the Contractor shall be aware that slope height, slope inclination and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state or federal safety regulations.

1.04 COORDINATION

A. Do not interrupt existing utilities serving facilities occupied and used by Owner or others except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided. Provide minimum of 48-hour notice prior to enacting an approved temporary interruption.

1.05 SUBMITTALS (RESERVED)

PART 2 – PRODUCTS (RESERVED)

PART 3 – EXECUTION

3.01 EXAMINATION

A. Site Information

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there from by Contractor. Data are made available for convenience of Contractor.
2. Contractor shall be responsible for determining the actual ground water elevation and soil conditions at the specific site prior to commencing with the excavation. It may be expedient to drill auger holes, excavate test pits or make additional soil borings at or adjacent to the construction area immediately prior to construction to determine the prevailing soil conditions and water table elevation. It is the Contractor's responsibility to make auger holes, excavate test pits or make additional soil borings, as he deems appropriate to determine the ground water and soil conditions that will be encountered. Additional test borings and other exploratory operations made by the Contractor shall be at no cost to the Owner.

3.02 PREPARATION

A. Establish extent of excavated areas.

B. Identify and set required lines, levels and contours.

C. Maintain benchmarks, monuments and other reference points.

D. Before starting excavation, establish location and extent of underground utilities occurring in work area. Contact Joint Utility Locating Information for Excavators (J.U.L.I.E.) (800) 892-0123 or all other utility companies on the project site which are not members of this system.

3.03 EXCAVATION

A. General

1. Excavation consists of removal and redistribution of material encountered when establishing required grade and subgrade elevations, including stripping of topsoil.
2. The Contractor is solely responsible for designing and constructing stable excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations shall comply with applicable local, state and federal safety regulations including the current OSHA Occupational Safety and Health Standards - Excavations, 29 CFR Part 1926, including any successor regulations.
3. All sheeting, shoring and bracing of trenches, pits and excavations shall be the sole responsibility of the Contractor.
4. Construction site safety is the sole responsibility of the Contractor, including but not limited to, the means, methods, and sequencing of construction operations.
5. Earth excavation consists of stripping of topsoil, removal and disposal of pavements

and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, material of any classification indicated in data on sub-surface conditions, and other materials encountered that are not classified as unauthorized excavation.

B. Unauthorized Excavation

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

C. Additional Excavation

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

D. Dewatering

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

E. Material Storage

1. Stockpile satisfactory excavated materials in the location designated by the Engineer or Owner, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations.

Do not store within drip line of trees indicated to remain. Contain excavated silt/soil runoff with silt fences in accordance with Local, State and Federal Requirements.

F. Excavation Near Utilities

1. Protect, support, shore, brace, etc. all utility services uncovered by excavation.
2. Accurately locate and record abandoned and active utility lines rerouted or extended, on Contract Documents.
3. Repair damaged utilities to the satisfaction of the Utility Owner.

G. Disposal of Excess and Waste Materials

1. Removal from Owner's Property

a. Remove waste materials, trash and debris and legally dispose of it off Owner's property.

2. Excess Material

a. Excess excavated material shall be removed from the site and properly disposed of.

H. Topsoil

1. Topsoil shall be stripped from site so that all organic materials, stumps, and roots are removed from the site.
2. Contractor shall stockpile sufficient clean topsoil onsite for reuse and shall dispose of all excess or unsuitable material in accordance with existing state and federal regulations.
3. Temporary topsoil stockpiles shall be temporarily stabilized as required.

3.04 FIELD QUALITY CONTROL

A. The Contractor shall allow bearing surfaces at the bottom of excavations to be inspected by the Engineer and shall modify the bearing surfaces as requested by the Engineer, prior to placement of any base materials.

B. Proofrolling. Subgrades shall be proofrolled to detect areas of insufficient compaction. Proofrolling shall be accomplished by making minimum of 2 complete passes with fully-loaded tandem-axle dump truck with a maximum weight of 20 tons, or approved equal, in each of 2 perpendicular directions while under the supervision and direction of the independent testing laboratory. Areas of failure shall be excavated and recompacted as specified herein. Continual failure areas shall be stabilized at no additional cost to Owner. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled.

3.05 PROTECTION

A. Stability of Excavation

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

B. Cold Weather Protection

1. Protect excavation bottoms against freezing when atmospheric temperature is less than $35^{O}F$ ($1^{O}C$).

C. Protection of Persons and Property

1. Fence and barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by authorities having jurisdiction.
2. Protect structures, landscaping, utilities, sidewalks, pavements or other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
3. Comply with current OSHA Occupational Safety and Health Standards - Excavations, 29 CFR Part 1926, including any successor regulations.

END OF SECTION 31 23 16

SECTION 31 23 23
FILL

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Preparation of subgrade for pavements, sidewalks and curb and gutters.

B. Backfill for site utilities.

C. Fill for over-excavation.

D. Consolidation and compaction of all fill material.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 31 23 16 – Excavation
2. Section 32 12 16 – Asphalt Paving
3. Section 32 13 13 – Concrete Paving

1.03 REFERENCE TO STANDARDS

A. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

B. ASTM D4253 - Maximum Index Density and Unit Weights of Soils Using a Vibratory Table.

C. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, Latest Edition.

D. Illinois Department of Transportation (IDOT) – Project Procedures Guide

1.04 REGULATORY REQUIREMENTS

A. Conform to the applicable portions of Sections 202, 205 and 301 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.

1.05 SUBMITTALS

A. Submit copies of Standard Proctor Density Test results to Engineer a minimum of seven

business days prior to backfilling any excavations.

1.06 QUALITY ASSURANCE

A. Compaction Testing

1. Standard Proctor Density Testing and Compaction Testing of fill materials and inspection of subgrades and fill layers will be performed by the Contractor's testing service, using Proctor information furnished by the Contractor.
2. If, in opinion of Engineer, based on testing service reports and inspection, subgrade or fills, which have been graded or placed on-site are below specified density, provide additional compaction and testing at no additional expense to the Owner.
3. When, during progress of work, tests indicate that compacted materials will not meet specifications, remove defective work, replace and retest at no additional cost to the Owner.
4. Ensure that all compacted fills are tested before proceeding with placement of surface materials.

1.07 FIELD TESTS

A. Compaction Tests

1. Contractor shall make arrangements with an independent laboratory for completing compaction tests and shall pay for those tests. They shall also make arrangements with testing firm to have sufficient number of personnel from the testing laboratory and testing equipment in good working order during all placement and compaction operations. Name of testing firm chosen by Contractor shall be submitted to Engineer for approval prior to beginning of backfilling. Engineer reserves right to reject testing firm at any time during construction and to require another testing firm to perform tests.

1.08 PROTECTION

A. Protect and avoid all existing underground utilities during construction operations. Repair of any utilities damaged by construction shall be the responsibility of the respective Contractor.

PART 2 – PRODUCTS

2.01 DEFINITIONS

A. Suitable Soil

1. Suitable soil is a soil having less than 5% organic matter by weight as determined by the Loss on Ignition Test (determine weight loss caused by heating sample to 500° C for 6 hours after drying in accordance with ASTM D-2216, "Laboratory

Determination of Moisture Content of Soil").

B. Unsuitable Soil

1. Unsuitable soil is a soil that contains 5% or more organic matter as determined by the Loss of Ignition Test previously specified, rubbish, vegetable matter of every kind, roots, and boulders larger than 5 inches in dimension which might interfere with the proper bonding to adjacent contact surfaces, or as otherwise determined unsuitable by the Engineer.

C. Cohesive Soil

1. Cohesive soil is a soil containing more than 50 percent fine material passing the No. 200 standard sieve, and with more than 15 percent clay-size particles smaller than 0.002 mm (2 microns). The soil matrix passing the No. 40 standard sieve exhibits dry (crushing) strength in the dry state and cohesive shear strength in the moist state, as well as being plastic in the moist state.

2.02 ENGINEERED FILL MATERIALS

A. General

1. Fill shall meet the requirements of IDOT CA-6 (Class C quality or better) or shall be composed of suitable lean (silty or sandy) clay with liquid limit no greater than 50% and plasticity index no greater than 25%. The on-site clay materials obtained from excavations may be allowed as engineered fill if the material meets these requirements.
2. Engage a qualified independent testing laboratory to test materials from on-site and off-site sources to test materials for conformance to this specification. The name of the testing laboratory shall be submitted to the Engineer for review prior to conducting any tests. Results of tests shall be submitted to the Engineer for review prior to engineered fill material being placed.

2.03 TRENCH BACKFILL MATERIALS

A. General Fill and Cohesive Backfill

1. Provide acceptable soil materials for backfill, free of clay lumps, rock or gravel larger than two inches in dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

B. Granular Backfill and Trench Backfill

1. Granular backfill shall consist of IDOT FA-1, FA-2, FA-5, FA-6, CA-6 or CA-7 or Native Local Bluff Sand. Granular backfill shall be used under steps, stoops, walks, roads, parking lots and against structure walls. (Minimum for inch depth below

walks, steps, etc.).

PART 3 – EXECUTION

3.01 EXAMINATION

A. Prior to placement of any fill or backfill and prior to placement of all subsequent fill lifts, contact Engineer for inspection and testing of excavation subgrade and testing of each compacted layer of fill and backfill material. Provide proctor information necessary for the Engineer to perform density testing on in-place backfill material.

3.02 PREPARATION

A. Backfilling and compaction shall not occur until the following conditions are satisfied:

1. Acceptance by Engineer of construction below finish grade.
2. Inspection, testing, approval and recording locations of underground utilities.
3. Removal of concrete formwork.
4. Removal of trash and debris, vegetation, snow or ice, water, unsatisfactory soil materials, obstructions and deleterious materials.
5. Removal of shoring and bracing and backfilling of voids with satisfactory material.
6. Ensure that ground surface within excavated area to be backfilled is not frozen.
7. When existing ground surface has a density less than that specified under Article 3.03-C of this Section for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content and compact to required depth and percentage of maximum density.

3.03 BACKFILLING AND COMPACTING

A. General

1. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

    a. In existing turf areas, use satisfactory excavated or borrow exterior fill material.

B. Placement and Compaction

1. Place backfill, base and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand operated tampers. Heavy equipment including compaction equipment shall not operate within 2 feet of unbraced substructure walls. Compaction in these areas shall be obtained with hand operated compaction equipment or devices. Earth backfill and native soil backfill shall be compacted with sheepsfoot compaction equipment.

2. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structure to required elevations. Take necessary precautions to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

C. Percentage of Maximum Density Requirements

1. Unless otherwise noted on the plan sheets, compact each layer of soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D698, Standard Proctor Compaction Test; and not less than the following percentages of relative density, determined in accordance with ASTM D 4253 and ASTM D 4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesion less soils).

REQUIRED COMPACTIVE EFFORT				
MATERIAL TESTED	PROCTOR TYPE	MIN % DRY DENSITY	MOISTURE CONTENT	MIN FREQUENCY OF TESTING
Engineered Fill	Standard	97%	-2 to +3%	1 per 2,500 sf of fill placed
Landscape Fill (non-load bearing)	Standard	90%	-2 to +3%	1 per 5,000 sf of fill placed
Utility Trench	Standard	97%	-2 to +3%	1 per 200 lf of backfill placed

D. Moisture Control

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water top surface or subgrade or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

E. Grading

1. General

a. Uniformly grade areas within limits of excavation under this Section, including adjacent transition areas. Compact with uniform levels or slopes between such points and existing grades.

b. Remove stones over 1-1/2" in any dimension and sticks, roots, rubbish and other extraneous matter.
c. Rough grade to 6" - 12" below finish, grades and elevations indicated in the drawings.
d. Grading Outside Structure Lines

1. Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
2. Finish surfaces free from irregular surface changes, and as follows:

a. Slabs: Shape surface of areas under slabs to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

2. Grading Surface of Backfill Under Walks and Slabs.

a. Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/4" when tested with a 10' straightedge.

3. Compaction

a. After grading, compact subgrade surfaces to the depth and percentage of maximum or relative density for each area classification.

F. Maintenance

1. Protection of Graded Areas

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

2. Reconditioning Compacted Areas

a. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required density prior to further construction.

3. Settling

a. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance,

quality and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

3.04 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction

1. Allow the Engineer to inspect subgrades and fill layers before further construction work is performed.
2. If in opinion of Engineer, based on field density testing and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense to the Owner.

END OF SECTION 31 23 23

SECTION 31 25 00
EROSION & SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Installation of temporary and permanent erosion and sedimentation control systems.

B. Installation of temporary and permanent slope protection systems.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 02 41 00 – Site Demolition
2. Section 31 11 00 – Site Clearing
3. Section 31 23 16 – Excavation
4. Section 31 23 23 – Fill
5. Section 32 92 00 – Seeding

1.03 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent properties, any identified endangered or threatened species and/or critical habitat, any identified cultural or historic resources, and receiving water resources from erosion and sediment damage until final stabilization is achieved. All storm water controls and systems must be installed & functioning as designed and free of accumulated sediment and debris before final project approval.

PART 2 – REFERENCE TO STANDARDS

2.01 Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, Latest Edition.

2.02 Illinois Urban Manual, latest edition.

PART 3 – PRODUCTS

3.01 MATERIALS

A. Turf and ground covers for the establishment of vegetation in accordance with Division 32.

B. All erosion control products, sediment control devices, or materials for non-storm water BMPs as specified herein and on the Construction Drawings.

C. Rolled erosion control products according to Erosion Control Technology Council (ECTC) standard specifications.

D. Temporary mulches such as loose straw or wood cellulose.

E. Temporary and permanent outfall structures as specified on the drawings.

3.02 SUBMITTALS

A. Contractor shall submit shop drawings or material certifications for all manufactured erosion and sediment control materials.

PART 4 – EXECUTION

4.01 PREPARATION

A. Review the drawings and Storm Water Pollution Prevention Plan.

B. Conduct storm water pre-construction meeting with all ground-disturbing contractors, site engineer of record or their representative who is familiar with the site and SWPPP, and state or local agency personnel if available.

C. Revise SWPPP as necessary to address potential pollution from site identified after issuance of the SWPPP at no additional cost to owner.

4.02 EROSION AND SEDIMENTATION CONTROL AND IMPLEMENTATION

A. Place erosion and sediment control systems in accordance with the drawings and Storm Water Pollution Prevention Plan or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

B. The Storm Water Pollution Prevention Plan and Site Maps shall be corrected or modified as site conditions change. Contractor must obtain approval from Owner's Engineer prior to modifying or substituting Best Management Practices. Changes during construction shall be noted in the Storm Water Pollution Prevention Plan and posted on the drawings (Site Maps).

C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.

D. Maintain erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or Owner to control sediment until final stabilization. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours at no additional cost to the Owner.

E. Contractor shall incorporate permanent erosion control features, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.

F. Permanently seed and mulch cut and fill slopes as construction proceeds to extent considered desirable and practical.

G. Disturbed areas that will not be graded or actively worked for the time frame established in the SWPPP and General Permit, shall be temporarily stabilized as work progresses with vegetation or other acceptable means in accordance with Division 32 or as otherwise shown on the plans unless otherwise specified in the Contract Documents. In the event it is not practical to seed areas, slopes must be stabilized with erosion control blankets, mulch and tackifier, bonded fiber matrix, netting, blankets or other means to reduce the erosive potential of the area.

H. Contractor shall adhere to all the terms and conditions as shown on the plans and contained in the IEPA General Permit and SWPPP.

I. Contractor shall provide qualified personnel, in accordance with the attached SWPPP, to inspect disturbed areas of the construction site that have not been finally stabilized, as required by the IEPA General Permit, at least once every seven (7) calendar days and within twenty-four (24) hours of the end of a storm that is 0.5 inches or greater or equivalent snowfall.

4.03 LOCAL JURISDICTIONAL APPROVAL

A. Prior to commencing construction, Contractor shall obtain all required County of City Erosion Control Permits and pay for any applicable fees.

END OF SECTION 31 25 00

SECTION 31 32 00

SOIL STABILIZATION (if required)

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Excavation and backfilling of subgrade for bridge lift stabilization.

B. Geotextile fabric and geogrid for stabilization of subgrade.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 31 23 16 – Excavation
2. Section 31 23 23 – Fill

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

B. Illinois Department of Transportation (IDOT):

1. Standard Specifications for Construction and Materials.

1.04 SUBMITTALS

A. Submit gradation and certification of material that is to be used to Engineer for review.

B. Submit name of each materials supplier and specific type and source of each material. Obtain approval of Owner/Engineer prior to change in source.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with state and local standards in conjunction with requirements specified herein.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Provide products from one of the following manufacturers as specified in the Materials paragraph below:

1. Mirafi Construction Products, Pendergrass, GA, (800) 685-9990, www.mirafi.com
2. WEBTEC, INC., Charlotte, NC, (800)438-0027, www.webtecgeos.com
3. Tensar Earth Technologies, Inc., Atlanta, GA, (888) 828-5126, www.tensarcorp.com
4. Thrace-LINQ, Inc., Summerville, SC, (843) 873-5800, www.thracelinq.com

2.02 MATERIALS

A. Bridge Lift Material: Material used for the bridge lift shall be in accordance with Article 1004.04 of IDOT's Standard Specifications. IDOT's gradation CA-2 & CA-6 will be required unless otherwise approved by the Engineer.

2.03 ACCESSORIES

A. Geotextile Fabric for Stabilization: Provide one of the following:

1. Mirafi HP 370 or HP 570, by TenCate.
2. SF40 or SF65, by DuPont.
3. GTF-200 or 300, by Thrace-LINQ.
4. TerraTex HD, by Hanes.

B. Geogrid for Stabilization: Provide one of the following:

1. Biaxial Geogrid Type 1 (formerly BX 1100), by Tensar.
2. Biaxial Geogrid Type 2 (formerly BX 1200), by Tensar.
3. Mirafi BXG 11, by TenCate.
4. Mirafi BXG 12, by TenCate.

PART 3 – EXECUTION

3.01 PREPARATION

A. Obtain approval before proceeding with installation.

B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.

C. Proofroll subgrade to identify areas in need of stabilization.

3.02 EQUIPMENT

A. Perform operations using suitable, well-maintained equipment capable of excavating subsoil and placing and compacting of material.

3.03 EXCAVATION

A. Excavate subsoil to depth sufficient to accommodate soil stabilization.

B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.

C. Do not excavate within normal 45 degree bearing splay of any foundation.

D. Notify Owner's Representative of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.

E. Correct areas over-excavated in accordance with Section 31 23 23 - Fill.

F. Remove excess excavated material from site.

3.04 GEOTEXTILE FABRIC AND/OR GEOGRID

A. Place geotextile fabric and/or geogrid over subsoil surface, lap edges and ends in accordance with manufacturer's recommendations in those areas that are shown on Construction Drawings or in those areas that need additional stabilization prior to placement of base course. Bridge lift sections may require the use of geotextile fabric and/or geogrid for stabilization prior to placement of fill.

B. Place geotextile fabric and/or geogrid in accordance with manufacturer's recommendations.

3.05 SOIL TREATMENT AND BACKFILLING

A. Bridge Lifts: Where indicated on Construction Drawings or as required after processing the subgrade in accordance with Section 301 of the IDOT Standard Specifications, treat prepared subgrade by application of a bridge lift. Bridging over existing soils shall be acceptable only when approved in writing by the Owner or Owner's Representative. Excavate 24" of unsuitable soil and place geotextile fabric over existing soils to be bridged. The geotextile fabric shall be appropriate for the bridge lift material being placed. Place bridge lift consisting of 18" CA-2 aggregate over geotextile fabric and cap with 6" of CA-6 aggregate. The Owner and the Owner's representative shall have sole discretion as to the acceptability of all submittals.

B. Backfill and compaction of treated subsoil shall be in accordance with Sections 31 23 23 - Fill.

C. Finish subgrade surface in accordance with Section 31 22 19 – Finish Grading.

D. Remove surplus mix materials from site.

3.06 FIELD QUALITY CONTROL

A. Responsibilities: Unless otherwise specified, the quality control tests and inspections specified below will be conducted by the Contractor at no additional cost to the Owner. The Contractor shall perform additional testing or inspection as considered necessary for assurance of quality control.

B. Field Density: Field in-place density shall be determined as specified in Section 31 23 23 - Fill.

C. If tests indicate work does not meet specified requirements, Contractor shall remove and replace work. Corrected areas shall be retested.

END OF SECTION 31 32 00

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 – GENERAL

1.01 WORK INCLUDES

A. Furnish, place and compact an aggregate base course under the proposed pavements to the depths and at the locations shown on the plans.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 31 23 16 – Excavation.
2. Section 31 23 23 – Fill.
3. Section 31 32 00 – Soil Stabilization.
4. Section 32 12 16 – Asphalt Paving.
5. Section 32 13 13 – Concrete Paving.

1.03 REGULATORY REQUIREMENTS

A. Conform to the applicable portions of Section 351 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.

1.04 SUBMITTALS

A. Submit gradation and certification of material that is to be used to Engineer for review.

B. Submit name of material supplier.

C. Submit copies of Standard Proctor Density Test results to Engineer a minimum of twenty-four (24) hours prior to paving.

1.05 QUALITY ASSURANCE

A. Compaction Testing

1. Standard Proctor Density Testing and Compaction Testing of all aggregate base courses will be performed by the Contractor's testing service, using Proctor information furnished by the Contractor.

2. If, in opinion of Engineer, based on testing service reports and inspection, subgrade or fills, which have been graded or placed on-site are below specified density, provide additional compaction and testing at no additional expense to the Owner.
3. When, during progress of work, tests indicate that compacted materials will not meet specifications, remove defective work, replace and retest at no additional cost to the Owner.
4. Ensure that all compacted subbases are tested before proceeding with placement of surface materials.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Type B: Material used for aggregate base course shall be in accordance with Article 1004.04 of IDOT's Standard Specifications. IDOT's gradation CA-6 will be required for all impervious paved surfaces unless otherwise approved by the Engineer.

PART 3 – EXECUTION

3.01 INSPECTION

A. Verify existing subgrade has been compacted and prepared and is dry and that all gradients and elevations are correct.

3.02 PREPARATION

A. Correct any irregularities in gradient and elevations by scarifying, reshaping and re-compacting.

B. Do not place fill on soft, muddy or frozen surfaces.

C. Prior to placement of aggregate base course, the subgrade shall be prepared in accordance with Section 301 of the IDOT Standard Specifications and shall be proofrolled to detect areas of insufficient compaction. Proofrolling shall be accomplished by making a minimum of 2 complete passes with a fully loaded tandem-axle dump trump with a maximum weight of 20 tons, or approved equal, in each of 2 perpendicular directions. The Contractor shall document all proofroll procedure and results. Areas of failure shall be stabilized in accordance with Section 31 32 00 – Soil Stabilization.

D. Maintain moisture content of the subgrade between -2% and +3% optimum at the time of paving.

3.03 AGGREGATE PLACEMENT

A. Spread aggregate over the prepared subgrade to the lines and grades shown in the plans in accordance with IDOT's Standard Specifications.

B. Compact base material to not less than 97% standard proctor.

C. Water shall be added as required by the Engineer to obtain satisfactory compaction.

3.04 TOLERANCES. Top surface of aggregate: Plus or minus 1/4 in.

3.05 SURPLUS MATERIALS

A. Remove surplus materials from site.

END OF SECTION 32 11 23

SECTION 32 13 13
CONCRETE PAVING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Concrete pavements.

B. Concrete sidewalks.

C. Concrete curb and gutters.

1.2 RELATED WORK

A. Specified elsewhere:

1. Section 02 4100 – Site Demolition
2. Section 31 2316 – Excavation
3. Section 31 2323 – Fill

1.3 REGULATORY REQUIREMENTS

A. Conform to the applicable portions of Section 420, 424 and 606 of the Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all Supplemental Specifications and Recurring Special Provisions.

B. Illinois Department of Transportation (IDOT) – Project Procedures Guide (March 1, 2006).

C. Applicable IDOT Highway Standards – Attached at end of this Section.

1.4 QUALITY ASSURANCE

A. Conform to the Illinois Department of Transportation's Recurring Special Provision Check Sheet #31, "Quality Control / Quality Assurance of Concrete Mixtures" (Revised January 1, 2009).

1.5 REFERENCES

A. American Concrete Institute (ACI) ACI 330R-08 – Guide for the Design and Construction of Concrete Parking Lots.

1.6 JOB CONDITIONS

A. Traffic Control:

1. Restrict traffic access from any concrete slab for a minimum 7 days unless tests are made to determine that the concrete has gained adequate strength.

1.7 SUBMITTALS

A. Submit under the provisions of Division 01 – Section 01 3300 – Submittals.

B. Submit mix designs, materials mix ratio and laboratory test data to the Engineer prior to beginning paving activities.

C. Submit jointing plan for each concrete pavement area to the Engineer for review and approval prior to beginning paving activities.

D. Submit product data for each joint sealant application and product indicated.

PART 2 - PRODUCTS

2.1 FORM MATERIALS, REINFORCEMENT AND CONCRETE

A. Materials: Conform to Section 1103 of the IDOT Standard Specifications for the given type of work to be performed, unless otherwise approved by the Engineer.

2.2 EXPANSION JOINTS

A. Materials: In conformance with IDOT Standard Specifications, except do not use bituminous poured joint materials in sidewalks; seal joints.

2.3 CONCRETE MIXES (PAVING)

A. Concrete: Conform to Section 1020 of the IDOT Standard Specifications for the given type of work to be performed, unless otherwise approved by the Engineer.

B. Do not use chloride or other chemicals to prevent freezing.

C. Provide 5.5% - 7% Air Entrainment (measured at the point of placement).

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect areas and conditions where concrete paving is to be installed.

1. Notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

3.2 FACILITIES

A. Locate manholes, valve boxes and similar items; adjust to proposed concrete surface elevation.

3.3 CONSTRUCTION METHODS

A. Concrete shall be placed in accordance IDOT's Standard Specifications.
B. Joints shall be constructed in accordance with the plans and details.

3.4 CONSTRUCTION TESTING

A. Contractor shall provide and pay for an independent testing company to complete the Quality Assurance tests outlined to be completed by the Department in IDOT's Standard Specification.

END OF SECTION 32 13 13