ROGERS SPORTS COMPLEX –
MINI MAJORS CONCESSION
RESTROOM BUILDING EXPANSION
FORT DODGE, IOWA
PROJECT NO. 125.919.01

Prepared by:

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The following documents are a part of this contract:

BIDDING INFORMATION AND CONTRACT DOCUMENTS

SPECIAL PROVISIONS

STANDARD SPECIFICATIONS

The most recent editions, as per the project letting date, of the Statewide Urban Design and Specifications (SUDAS) Standard Specifications, the Iowa Department of Transportation (Iowa DOT) Standard Specifications (where applicable), and the Iowa DOT Materials I.M.s (where applicable), shall apply to all work performed on this project unless otherwise noted herein, or within the City of Fort Dodge Supplemental Specifications or Special Provisions included in the Contract Documents.

TECHNICAL SPECIFICATIONS

The following technical specification sections represent specialty work and are to override or supplement any SUDAS requirements.

BIDDING INFORMATION AND CONTRACT DOCUMENTS

NOTICE TO BIDDERS
JURISDICTION OF CITY OF FORT DODGE PUBLIC IMPROVEMENT PROJECT

Notice is hereby given that a public hearing will be held by the ***City of Fort Dodge*** on the proposed contract documents (plans, specifications, and form of contract) and estimated cost for the improvement at its meeting at ***6:00 P.M.*** on ***November 10th, 2025*** in said **Fort Dodge City Hall at 819 1st Avenue South, Fort Dodge, Iowa.**

Sealed bids for the work comprising each improvement as stated below must be filed before ***10:00 A.M.*** on ***November 4th, 2025,*** in the office of the **City Clerk of City of Fort Dodge, Iowa.** Bids received after the deadline for submission of bids as stated herein shall not be considered and shall be returned to the late bidder unopened.

Sealed proposals will be opened, and bids tabulated at ***10:00 A.M.*** on ***November 4th, 2025***, in the **Fort Dodge Council Chambers** for consideration by the **City of Fort Dodge** at its meeting on ***November 10th, 2025.***

Pre-Bid Conference

A **pre-bid conference** will be held for this project at 10:00 A.M on Tuesday, October 28, 2025. Attendance of the meeting is not mandatory, but potential bidders are encouraged to visit the site and become familiar with the existing condition for bidding purposes.

Contract Documents

The contract documents may be examined at the **City of Fort Dodge, Office of City Clerk at City Hall**. Electronic contract documents are available at no cost by clicking on "Clients" then "Bids" at www.snyder-associates.com and choosing the **ROGERS SPORTS COMPLEX - MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION** on the list. Project information, Engineer's cost opinion, and plan holder information is also available at no cost at this website. Downloads require the user to register for a free membership at QuestCDN.com.

Preference of Products and Labor

By virtue of statutory authority, preference will be given to products and provisions grown and coal produced within the State of Iowa, and to Iowa domestic labor, to the extent lawfully required under Iowa statutes.

In accordance with Iowa statutes, a resident bidder shall be allowed a preference as against a nonresident bidder from a state or foreign country if that state or foreign country gives or requires any preference to bidders from that state or foreign country, including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country. The preference allowed shall be equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident. In the instance of a resident labor force preference, a nonresident bidder shall apply the same resident labor force preference to a public improvement in this state as would be required in the construction of a public improvement by the state or foreign country in which the nonresident bidder is a resident.

General Nature of the Public Improvement

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT # 125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

Bid Security

Each bidder shall accompany its bid with bid security as defined in Iowa Code Section 26.8, as security that the successful bidder will enter into a contract for the work bid upon and will furnish after the award of contract a corporate surety bond, in a form acceptable to the Jurisdiction, for the faithful performance of the contract, in an amount equal to 100% of the amount of the contract. The bidder's security shall be in the amount fixed in the Instruction to Bidders and shall be in the form of a cashier's check or a certified check drawn on an FDIC insured bank in Iowa or on an FDIC insured bank chartered under the laws of the United States; or a certified share draft drawn on a credit union in Iowa or chartered under the laws of the United States; or a bid bond on the form provided in the contract documents with corporate surety satisfactory to the Jurisdiction. The bid shall contain no condition except as provided in the specifications.

The **CITY OF FORT DODGE** reserves the right to defer acceptance of any bid for a period of sixty (60) calendar days after receipt of bids and no bid may be withdrawn during this period.

Performance, Payment and Maintenance Bond

Each successful bidder will be required to furnish a corporate surety bond in an amount equal to 100% of its contract price. Said bond shall be issued by a responsible surety approved by **CITY OF FORT DODGE** and shall guarantee the faithful performance of the contract and the terms and conditions therein contained and shall guarantee the prompt payment of all material and labor, and protect and save harmless **CITY OF FORT DODGE** from claims and damages of any kind caused by the operations of the contract and shall also guarantee the maintenance of the improvement caused by failures in materials and construction for a period of two years from and after acceptance of the contract. The guaranteed maintenance period for new paving shall be four years.

Title VI Compliance

The **CITY OF FORT DODGE**, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally-assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all bidders that it will affirmatively insure that in any contract entered into pursuant to this advertisement, minority business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

Commencement of Work

Work on the improvement shall be commenced any time after the after a written Notice to Proceed is issued, no later than **November 15th, 2025**, and shall be completed as stated below. The Notice to Proceed will be issued after the preconstruction conference, which is expected to occur the week of November 11th, 2025.

Completion of Work

Work on the project shall start as early as possible. Work on the project shall be substantially complete by May 1st, 2026. Final Completion of all project work, punch-list items, and close-out procedures shall be completed by June 1st, 2026.

Should the contractor fail to complete the work in this timeframe, liquidated damages of **One Thousand dollars ($1,000.00**) per calendar day will be assessed for work not completed within the designated contract term.

The **CITY OF FORT DODGE** does hereby reserve the right to reject any or all bids, to waive informalities, and to enter into such contract, or contracts, as it shall deem to be in the best interest of the jurisdiction.

This Notice is given by authority of the **CITY OF FORT DODGE**

_____
Dawn Siebken, City Clerk
CITY OF FORT DODGE

NOTICE OF HEARING

NOTICE OF PUBLIC HEARING ON PROPOSED PLANS, SPECIFICATIONS, FORM OF CONTRACT, AND ESTIMATE OF COST FOR THE **CITY OF FORT DODGE**.

Public Notice is hereby given that at ***6:00 P.M.*** on the ***10th*** **day of** ***November, 2025***, the **City Council of the City of Fort Dodge, Iowa** will, in the **Fort Dodge City Hall at 819 1ST Avenue South, Fort Dodge, IA**, hold a hearing whereat said ***Council*** will resolve to adopt plans, specifications, form of contract and estimate of cost for the construction of the **ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION** and, at the time, date and place specified above, or at such time, date and place as then may be fixed, to act upon proposals and enter into contract for the construction of said improvements.

General Nature of the Public Improvement

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT # 125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

At said hearing, the **City Council** will consider the proposed plans, specifications, form of contract and estimate of cost for said project, the same now being on file in the **Office of the City Clerk of the City of Fort Dodge, Iowa at City Hall**, reference to which is made for a more detailed and complete description of the proposed improvements, and at said time and place the said Council will also receive and consider any comments/objections to said plans, specifications and form of contract or to the estimated cost of said improvements made by any interested party.

This Notice is given by authority of the **City Council of the City of Fort Dodge, Iowa**

Dawn Siebken
City Clerk
City of Fort Dodge

Published in **The Messenger on _____ day of _____, 2025.**

INSTRUCTIONS TO BIDDERS

Project Name: **ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION**

The work comprising the above referenced project shall be constructed in accordance with the construction plans and the technical specifications, and as further modified by supplemental specifications and special provisions included in the contract documents. The terms used in the contract revision of the documents are defined in said Standard Specifications. Before submitting your bid, review the requirements of Division 1, General Provisions and Covenants, in particular the sections regarding proposal requirements, bonding, contract execution and insurance requirements. Be certain that all documents have been completed properly, as failure to complete and sign all documents and to comply with the requirements listed below can cause your bid not to be read.

I. BID SECURITY

The bid security must be in the minimum amount of **10%** of the total bid amount including all add alternates (do not deduct the amount of deduct alternates). Bid security shall be in the form of a cashier's check or a certified check, drawn on an FDIC insured bank in Iowa or drawn on an FDIC insured bank chartered under the laws of the United States; or a certified share draft drawn on a credit union in Iowa or chartered under the laws of the United States; or a bid bond executed by a corporation authorized to contract as a surety in Iowa or satisfactory to the Jurisdiction. The bid bond must be submitted on the enclosed Bid Bond form as no other bid bond forms are acceptable. All signatures on the bid bond must be original signatures in ink; facsimile (fax) of any signature or use of an electronic signature on the bid bond is not acceptable. Bid security other than said bid bond shall be made payable to **City of Fort Dodge, Iowa**. "Miscellaneous Bank Checks," and personal checks, as well as "Money Orders" and "Traveler's Checks" issued by persons, firms, or corporations licensed under Chapter 533C of the Iowa Code, are not acceptable bid security.

II. SUBMISSION OF THE PROPOSAL AND IDENTITY OF BIDDER

A. The proposal shall be sealed in an envelope, properly identified as the Proposal with the project title and the name and address of the bidder and deposited with the Jurisdiction at or before the time and at the place provided in the Notice to Bidders. It is the sole responsibility of the bidder to see that its proposal is delivered to the Jurisdiction prior to the time for opening bids, along with the appropriate bid security sealed in a separate envelope identified as Bid Security and attached to the outside of the bid proposal envelope. Any proposal received after the scheduled time for the receiving of proposals will be returned to the bidder unopened and will not be considered. If the Jurisdiction provides envelopes for proposals and bid security, bidders shall be required to utilize such envelopes in the submission of their bids.

B. The following documents shall be completed, signed, and returned in the Proposal envelope. The bid cannot be read if any of these documents are omitted from the Proposal envelope.

1. PROPOSAL – Complete each of the following parts:

- Part B – Acknowledgment of Addenda, if any have been issued
- Part C – Bid Items, Quantities, and Prices, including Bid Alternate
- Part F – Additional Requirements

The following proposal attachments must be completed and attached:

ITEM NO.	DESCRIPTION OF ATTACHMENT
1.	TSB Provisions
2.	
3.	
4.	
5.	
6.	

- Part G – Identity of Bidder (including the Bidder Status Form)

Sign the proposal. The signature on the proposal and all proposal attachments must be an original signature in ink signed by the same individual who is the Company Owner or an authorized Officer of the Company; copies or facsimile of any signature or electronic signatures will not be accepted. The Bidder Status Form is required by the Iowa Labor Commissioner, pursuant to the Iowa Administrative Code rule 875-156.2(1). The Bidder must complete and submit the Bidder Status Form, signed by an authorized representative of the Bidder, with their bid proposal. Under Iowa Administrative Code rule 875-156.2(1), failure to provide the Bidder Status Form with the bid may result in the bid being deemed non-responsive and may result in the bid being rejected. The Worksheet: Authorized to Transact Business from the Labor Commissioner is including on the following page and can be used to assist Bidders in completing the Bidder Status Form.

The following documents must be submitted as printed. No alterations, additions, or deletions are allowed. If the Bidder notes a requirement in the contract documents that the Bidder believes will require a conditioned or unsolicited alternate bid, the Bidder must immediately notify the Engineer in writing. The Engineer will issue any necessary interpretation by an addendum.

PROPOSAL

PROPOSAL: PART A – SCOPE

The City of Fort Dodge, Iowa, hereinafter called the "Jurisdiction," has need of a qualified contractor to complete the work comprising the below referenced improvement. The undersigned Bidder hereby proposes to complete the work comprising the below referenced improvement as specified in the contract documents, which are officially on file with the Jurisdiction, in the office of the City Clerk, at the prices hereinafter provided in Part C of the Proposal, for the following described improvements:

PROJECT DESCRIPTION:

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT #125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

PROPOSAL: PART B – ACKNOWLEDGMENT OF ADDENDA

The Bidder hereby acknowledges that all addenda become a part of the contract documents when issued, and that each such addendum has been received and utilized in the preparation of this bid. The Bidder hereby acknowledges receipt of the following addenda by inserting the number of each addendum in the blanks below:

ADDENDUM NUMBER _____ ADDENDUM NUMBER _____

ADDENDUM NUMBER _____ ADDENDUM NUMBER _____

and certifies that said addenda were utilized in the preparation of this bid.

PROPOSAL: PART C – BID ITEMS, QUANTITIES, AND PRICES

LUMP SUM PRICE CONTRACTS: The Bidder must provide the lump sum Total Bid Price and any Alternate Prices on the Proposal Attachment: Part C – Bid Items, Quantities, and Prices. The bidder must submit bids for all Alternates. The Total Construction Cost plus any Alternates selected by the Jurisdiction shall be used only for comparison of bids. The Total Construction Cost, including the sum of any selected Alternates, shall be used for determining the sufficiency of the bid security.

PROPOSAL: PART D – GENERAL

The Bidder hereby acknowledges that the Jurisdiction, in advertising for public bids for this project, reserves the right to:

1. Reject any or all bids. Award of the contract, if any, to be to the lowest responsible, responsive bidder; and
2. Reject any or all alternates in determining the items to be included in the contract. Designation of the lowest responsible, responsive bidder to be based on comparison of the total bid plus any selected alternates; and
3. Make such alterations in the contract documents or in the proposal quantities as it determines necessary in accordance with the contract documents after execution of the contract. Such alterations shall not be considered a waiver of any conditions of the contract documents, and shall not invalidate any of the provisions thereof; and

The Bidder hereby agrees to:

1. Enter into a contract, if this proposal is selected, in the form approved by the Jurisdiction, provide proof of registration with the Iowa Division of Labor in accordance with Chapter 91C of the Iowa Code, and furnish a performance, maintenance, and payment bond; and
2. Forfeit bid security, not as a penalty but as liquidated damages, upon failure to enter into such contract and/or to furnish said bond; and
3. Commence the work on this project on or before a date to be specified in a written notice to proceed by the Jurisdiction, and to fully complete ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION; and to pay liquidated damages for noncompliance with said completion provisions at the rate of One Thousand dollars ($1,000) for each calendar day thereafter that the work remains incomplete.

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PROPOSAL: PART E – NON-COLLUSION AFFIDAVIT

The Bidder hereby certifies:

1. That this proposal is not affected by, contingent on, or dependent on any other proposal submitted for any improvement with the Jurisdiction; and

2. That no individual employed by the Bidder has employed any person to solicit or procure the work on this project, nor will any employee of the Bidder make any payment or agreement for payment of any compensation in connection with the procurement of this project; and

3. That no part of the bid price received by the Bidder was or will be paid to any person, corporation, firm, association, or other organization for soliciting the bid, other than the payment of their normal compensation to persons regularly employed by the Bidder whose services in connection with the construction of the project were in the regular course of their duties for the Bidder; and

4. That this proposal is genuine and not collusive or sham; that the Bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to submit a sham bid or to refrain from bidding, and has not in any manner, directly or indirectly, sought, by agreement or collusion, or communication or conference, with any person, to fix the bid price of the Bidder or of any other bidder, and that all statements in this proposal are true; and

5. That the individual(s) executing this proposal have the authority to execute this proposal on behalf of the Bidder.

PROPOSAL: PART F – ADDITIONAL REQUIREMENTS

The Bidder hereby agrees to comply with the additional requirements listed below that are included in this proposal and identified as proposal attachments:

ITEM NO.	DESCRIPTION OF ATTACHMENT
1.	_____
2.	_____
3.	_____
4.	_____
5.	_____
6.	_____

PROPOSAL: PART G – IDENTITY OF BIDDER

The Bidder shall indicate whether the bid is submitted by a/an:

- ☐ Individual, Sole Proprietorship
- ☐ Partnership
- ☐ Corporation
- ☐ Limited Liability Company
- ☐ Joint-venture: all parties must join-in and execute all documents
- ☐ Other

The Bidder shall enter its Public Registration Number ___ ___ ___ ___ ___ - ___ ___ issued By the Iowa Commissioner of Labor Pursuant Section 91C.5 of the Iowa Code.

Failure to provide said Registration Number shall result in the bid being read under advisement. A contract will not be executed until the Contractor is registered.

_____
Bidder

_____
Signature

By _____
Name (Print/Type)

_____
Title

_____
Street Address

_____
City, State, Zip Code

_____
Telephone Number

Type or print the name and title of the company's owner, president, CEO, etc. if a different person than entered above

_____
Name

_____
Title

NOTE: The signature on this proposal must be an original signature in ink; copies, facsimiles, or electronic signatures will not be accepted.

PROPOSAL

PROPOSAL ATTACHMENT: PART C – BID ITEMS, QUANTITIES, AND PRICES

This is a UNIT BID PRICE CONTRACT. The bidder must provide the Bid Price(s), Bid Alternate Item Price(s), and the Total of the Total Construction Cost plus the total of the individual Bid Alternate in this Proposal Attachment: Part C – Bid Items, Quantities, and Prices the total of the base bid plus any alternate selected by the Jurisdiction shall be used only for comparison of bids. The bidder must submit bids for all alternates to be deemed responsive. The total of the Total Construction Cost plus the sum of any selected Alternates shall be used for determining the sufficiency of the bid security.

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	TOTAL PRICE
	BASE BID				
1.	Select Building Demolition	1	LS	$	$
2.	Existing Building Floor Reinforcing and Wall/Roof Modifications	1	LS	$	$
3.	Existing Masonry Wall Cleaning/Sealing and Vent Installation	1	LS	$	$
4.	Press Box 2nd Story Addition	1	LS	$	$
5.	Stairs	1	LS	$	$
6.	Casework	1	LS	$	$
7.	Gutters and Downspouts	1	LS	$	$
8.	Overhead Netting, Anchorages, Poles, and Foundations	1	LS	$	$
				TOTAL BASE BID:	**$**
	ADD ALTERNATE NO. 1				
9.	Variable Refrigerant Air-Cooled Condensing Unit System (VRF)	1	LS	$	$
				TOTAL ADD ALTERNATE NO. 1:	**$**

Worksheet: Authorization to Transact Business

This worksheet may be used to help complete Part A of the Resident Bidder Status form. If at least one of the following describes your business, you are authorized to transact business in Iowa.

☐ Yes ☐ No My business is currently registered as a contractor with the Iowa Division of Labor.

☐ Yes ☐ No My business is a sole proprietorship and I am an Iowa resident for Iowa income tax purposes.

☐ Yes ☐ No My business is a general partnership or joint venture. More than 50 percent of the general partners or joint venture parties are residents of Iowa for Iowa income tax purposes.

☐ Yes ☐ No My business is an active corporation with the Iowa Secretary of State and has paid all fees required by the Secretary of State, has filed its most recent biennial report, and has not filed articles of dissolution.

☐ Yes ☐ No My business is a corporation whose articles of incorporation are filed in a state other than Iowa, the corporation has received a certificate of authority from the Iowa Secretary of State, has filed its most recent biennial report with the Secretary of State, and has neither received a certificate of withdrawal from the Secretary of state nor had its authority revoked.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in this state and the statement has not been canceled.

☐ Yes ☐ No My business is a limited liability partnership which has filed a statement of qualification in a state other than Iowa, has filed a statement of foreign qualification in Iowa and a statement of cancellation has not been filed.

☐ Yes ☐ No My business is a limited partnership or limited liability limited partnership which has filed a certificate of limited partnership in this state, and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited partnership or a limited liability limited partnership whose certificate of limited partnership is filed in a state other than Iowa, the limited partnership or limited liability limited partnership has received notification from the Iowa Secretary of state that the application for certificate of authority has been approved and no notice of cancellation has been filed by the limited partnership or the limited liability limited partnership.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in Iowa and has not filed a statement of termination.

☐ Yes ☐ No My business is a limited liability company whose certificate of organization is filed in a state other than Iowa, has received a certificate of authority to transact business in Iowa and the certificate has not been revoked or canceled.

All bidders must submit the following completed form to the governmental body requesting bids per 875 Iowa Administrative Code Chapter 156.

Bidder Status Form

To be completed by all bidders — Part A

Please answer "Yes" or "No" for each of the following:

☐ Yes ☐ No My company is authorized to transact business in Iowa.
(To help you determine if your company is authorized, please review the worksheet on the next page).

☐ Yes ☐ No My company has an office to transact business in Iowa.

☐ Yes ☐ No My company's office in Iowa is suitable for more than receiving mail, telephone calls, and e-mail.

☐ Yes ☐ No My company has been conducting business in Iowa for at least 3 years prior to the first request for bids on this project.

☐ Yes ☐ No My company is not a subsidiary of another business entity or my company is a subsidiary of another business entity that would qualify as a resident bidder in Iowa.

If you answered "Yes" for each question above, your company qualifies as a resident bidder. Please complete Parts B and D of this form.

If you answered "No" to one or more questions above, your company is a non-resident bidder. Please complete Parts C and D of this form.

To be completed by resident bidders — Part B

My company has maintained offices in Iowa during the past 3 years at the following addresses:

Dates: _____ to _____ Address: _____
(mm/dd/yyyy) City, State, Zip: _____

Dates: _____ to _____ Address: _____
(mm/dd/yyyy) City, State, Zip: _____

Dates: _____ to _____ Address: _____
(mm/dd/yyyy) City, State, Zip: _____

You may attach additional sheet(s) if needed.

To be completed by non-resident bidders — Part C

1. Name of home state or foreign country reported to the Iowa Secretary of State:

   _____

2. Does your company's home state or foreign country offer preferences to bidders who are residents? ☐ Yes ☐ No

3. If you answered "Yes" to question 2, identify each preference offered by your company's home state or foreign country and the appropriate legal citation.

   _____

   _____

   You may attach additional sheet(s) if needed.

To be completed by all bidders — Part D

I certify that the statements made on this document are true and complete to the best of my knowledge and I know that my failure to provide accurate and truthful information may be a reason to reject my bid.

Firm Name: _____

Signature: _____ Date: _____

CONTRACT PROVISION

Targeted Small Business (TSB) Affirmative Action Responsibilities on Non-Federal-aid Projects (Third-party State-Assisted Projects)

1. TSB DEFINITION

A TSB is a small business, as defined by Iowa Code Section 15.102(10), which is 51% or more owned, operated and actively managed by one or more women, minority persons, service-disabled veterans or persons with a disability provided the business meets all of the following requirements: is located in this state, is operated for profit and has an annual gross income of less than 4 million dollars computed as an average of the three preceding fiscal years.

2. TSB REQUIREMENTS

In all State-assisted projects made available through the Iowa Department of Transportation, local governments have certain affirmative action requirements to encourage and increase participation of disadvantaged individuals in business enterprises. These requirements are based on Iowa Code Section 19B.7. These requirements supersede all existing TSB regulations, orders, circulars and administrative requirements.

3. TSB DIRECTORY INFORMATION

Available from: Iowa Economic Development Authority
Targeted Small Business Certification Program
200 East Grand Avenue
Des Moines, IA 50309
Phone: (515-348-6159)
Website: https://iowaeconomicdevelopment.com/tsb

4. THE CONTRACTOR'S TSB POLICY

The contractor is expected to promote participation of disadvantaged business enterprises as suppliers, manufactures and subcontractors through a continuous, positive, result-oriented program. Therefore, the contractor's TSB policy shall be:

> It is the policy of this firm that Targeted Small Business (TSB) concerns shall have the maximum practical opportunity to participate in contracts funded with State-assisted funds which are administered by this firm (e.g. suppliers, manufactures and subcontractors). The purpose of our policy is to encourage and increase the TSB participation in contracting opportunities made available by State-assisted programs.

5. CONTRACTOR SHALL APPOINT AN EQUAL EMPLOYMENT OPPORTUNITY (EEO) OFFICER

The contractor shall designate a responsible person to serve as TSB officer to fulfill the contractors affirmative action responsibilities. This person shall have the necessary statistics, funding, authority and responsibility to carry out and enforce the firm's EEO policy. The EEO officer shall be responsible for developing, managing and implementing the program on a day-to-day basis. The officer shall also:

A. For current TSB information, contact the Iowa Economic Development Authority (515-348-6159) to identify potential material suppliers, manufactures and contractors.

B. Make every reasonable effort to involve TSBs by soliciting quotations from them and incorporating them into the firm's bid.

C. Make every reasonable effort to establish systematic written and verbal contact with those TSBs having the materials or expertise to perform the work to be subcontracted, at least two weeks prior to the time quotations are to be submitted. Maintain complete records of negotiation efforts.

D. Provide or arrange for assistance to TSBs in seeking bonding, analyzing plans/specifications or other actions that can be viewed as technical assistance.

E. Ensure the scheduled progress payments are made to TSBs as agreed in subcontract agreements.

F. Require all subcontractors and material suppliers to comply with all contract equal opportunity and affirmative action provisions.

6. COUNTING TSBs PARTICIPATION ON A PROJECT

TSBs are to assume actual and contractual responsibilities for provision of materials/supplies, subcontracted work or other commercially useful function.

A. The bidder may count:

(1) Planned expenditures for materials/supplies to be obtained from TSB suppliers and manufacturers; or
(2) Work to be subcontracted to a TSB; or
(3) Any other commercially useful function.

B. The contractor may count:

(1) 100% of an expenditure to a TSB manufacturer that produces/supplies goods manufactured from raw materials.
(2) 60% of an expenditure to TSB suppliers that are not manufacturers; provided the suppliers perform a commercially useful function in the supply process.
(3) Only those expenditures to TSBs that perform a commercially useful function in the work of a contract, including those as a subcontractor.
(4) Work the Contracting Authority has determined that it involves a commercially usefulfunction. The TSB must have a necessary and useful role in the transaction of a kind for which there is a market outside the context of the TSB program. For example, leasing equipment or purchasing materials from the prime contractor would not count.

7. REQUIRED DATA, DOCUMENTS AND CONTRACT AWARD PROCEDURES FROM BIDDERS/CONTRACTORS FOR PROJECTS WITH ASSIGNED GOALS

A. Bidders

Bidders who fail to demonstrate reasonable positive efforts may be declared ineligible to be awarded the contract. Bidders shall complete the bidding documents plus a separate form called "TSB Pre-Bid Contact Information". This form includes:
(1) Name(s) of the TSB(s) contacted regarding subcontractable items.
(2) Date ofthe contract.
(3) Whether or not a TSB bid/quotation was received.
(4) Whether or not the TSB's bid/quotation was used.
(5) The dollar amount proposed to be subcontracted.

B. Contractors Using Quotes From TSBs

Use those TSBs whose quotes are listed in the "Quotation Used in Bid" column along with a "yes" indicated on the Pre-bid Contact Information form.

C. Contractors NOT Using Quotes From TSBs

If there are no TSBs listed on the Pre-bid Contract Information form, then the contractor shall document all efforts made to include TSB participation in this project by documenting the following:

(1) What pre-solicitation or pre-bid meetings scheduled by the contracting authority were attended?
(2) Which general news circulation, trade associations and/or minority-focused media were advertised concerning the subcontracting opportunities?
(3) Were written notices sent to TSBs that TSBs were being solicited and was sufficient time allowed for the TSBs to participate effectively?
(4) Were initial solicitations of interested TSBs followed up?
(5) Were TSBs provided with adequate information about the plans, specifications and requirements of the contract?
(6) Were interested TSBs negotiated with in good faith? If a TSB was rejected as unqualified, was the decision based on an investigation of their capabilities?
(7) Were interested TSBs assisted in obtaining bonding, lines of credit or insurance required by the contractor?
(8) Were services used of minority community organization, minority contractors' groups; local, State and Federal minority business assistance offices or any other organization providing such assistance.

The above documentation shall remain in the contractor's files for a period of three (3) years after the completion of the project and be available for examination by the Iowa Economic Development Authority.

8. POSITIVE EFFORT DOCUMENTATION WHEN NO GOALS ARE ASSIGNED

Contractors are also required to make positive efforts in utilizing TSBs on all State-assisted projects which are not assigned goals. Form "TSB Pre-bid Contact Information" is required to be submitted with bids on all projects. If there is no TSB participation, then the contractor shall comply with section 7C. of this document prior to the contract award.

Form 730007WP 7-97

Contractor _____ Page#_____

Project# _____

County _____

City _____

TARGETED SMALL BUSINESS (TSB)

PRE-BID CONTACT INFORMATION

(To Be Completed By All Bidders Per The Current Contract Provision)

In order for your bid to be considered responsive, you are required to provide information on this form showing your Targeted Small Business contacts made with your bid submission. This information is subject to verification and confirmation.

In the event it is determined that the Targeted Small Business goals are not met, then before awarding the contract, the Contracting Authority will make a determination as to whether or not the apparent successful low bidder made good faith efforts to meet the goals.

NOTE: Every effort shall be made to solicit quotes or bids on as many subcontractable items as necessary to achieve the established goals. If a TSB's quote is used in the bid, it is assumed that the firm listed will be used as a subcontractor.

TABLE OF INFORMATION SHOWING BIDDERS PRE-BID
TARGETED SMALL BUSINESS (TSB) CONTACTS

SUBCONTRACTOR	TSB	DATES CONTACTED	QUOTES RECEIVED		QUOTATION USED IN BID	
			YES/ NO	DATES CONTACTED	YES/ NO	DOLLAR AMT. PROPOSED TO BE SUBCONTRACTED

Total dollar amount proposed to be subcontracted to TSB on this project $_____ List items by name to be subcontracted:

BID BOND

KNOW ALL BY THESE PRESENTS:

That we, _____, as Principal, and _____, as Surety, are held and firmly bound unto_____, as Obligee, (hereinafter referred to as "the Jurisdiction"), in the penal sum of _____ _____dollars ($_____), or 10% percent of the amount bid in lawful money of the United States, for which payment said Principal and Surety bind themselves, their heirs, executors, administrators, successors, and assigns jointly and severally, firmly by these presents.

The condition of the above obligation is such that whereas the Principal has submitted to the Jurisdiction a certain proposal, in a separate envelope, and hereby made a part hereof, to enter into a contract in writing, for the following described improvements;

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT #125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

The Surety hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Jurisdiction may accept such bid or execute such Contract; and said Surety does hereby waive notice of any such extension.

In the event that any actions or proceedings are initiated with respect to this Bond, the parties agree that the venue thereof shall be Webster County, State of Iowa. If legal action is required by the Jurisdiction against the Surety or Principal to enforce the provisions of the bond or to collect the monetary obligation incurring to the benefit of the Jurisdiction, the Surety or Principal agrees to pay the Jurisdiction all damages, costs, and attorney fees incurred by enforcing any of the provisions of this Bond. All rights, powers, and remedies of the Jurisdiction hereunder shall be cumulative and not alternative and shall be in addition to all rights, powers and remedies given to the Jurisdiction, by law. The Jurisdiction may proceed against Surety for any amount guaranteed hereunder whether action is brought against Principal or whether Principal is joined in any such action or actions or not.

NOW, THEREFORE, if said proposal by the Principal be accepted, and the Principal shall enter into a contract with Jurisdiction in accordance with the terms of such proposal, including the provision of insurance and of a bond as may be specified in the contract documents, with good and sufficient surety for the faithful performance of such contract, for the prompt payment of labor and material furnished in the prosecution thereof, and for the maintenance of said improvements as may be required therein, then this obligation shall become null and void; otherwise, the Principal shall pay to the Jurisdiction the full amount of the bid bond, together with court costs, attorney's fees, and any other expense of recovery.

Signed and sealed this _____ day of _____, 20_____.

SURETY:	PRINCIPAL:
_____ Surety Company	_____ Bidder
By _____ Signature Attorney-in-Fact/Officer	By _____ Signature
_____ Printed Name of Attorney-in-Fact/Officer	_____ Printed Name
_____ Company Name	_____ Title
_____ Company Address	_____ Address
_____ City, State, Zip Code	_____ City, State, Zip Code
_____ Company Telephone Number	_____ Telephone Number

NOTE: All signatures on this bid bond must be original signatures in ink; copies, facsimile, or electronic signatures will not be accepted. This bond must be sealed with the Surety's raised, embossing seal. The Certificate or Power of Attorney accompanying this bond must be valid on its face and sealed with the Surety's raised, embossing seal.

CONTRACT NO. 125.0919.01

DATE _____

CONTRACT

THIS CONTRACT, made and entered into at City of Fort Dodge, Iowa this _____ day of _____, 2025, by and between the City of Fort Dodge by its Mayor upon order of its City Council hereinafter called the "Jurisdiction," and _____, hereinafter called the "Contractor."

WITNESSETH:

The Contractor hereby agrees to complete the work comprising the below referenced improvement as specified in the contract documents, which are officially on file with the Jurisdiction, in the office of the City Clerk. This contract includes all contract documents. The work under this contract shall be constructed in accordance with the SUDAS Standard Specifications, 2025 Edition, and as further modified by the supplemental specifications and special provisions included in said contract documents, and the Contract Attachment - Item 1: General, which is attached hereto. The Contractor further agrees to complete the work in strict accordance with said contract documents, and to guarantee the work as required by law, for the time required in said contract documents, after its acceptance by the Jurisdiction.

This contract is awarded and executed for completion of the work specified in the contract documents for the bid prices shown on the Contract Attachment - Item 2: Bid Items, Quantities, and Prices, which were proposed by the Contractor in its proposal submitted in accordance with the Notice to Bidders and Notice of Public Hearing for the following described improvements:

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT #125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

The Contractor agrees to perform said work for and in consideration of the Jurisdiction's payment of the bid amount of _____ dollars ($_____) which amount shall constitute the required amount of the performance, maintenance, and payment bond. The Contractor hereby agrees to commence work under this contract on or before a date to be specified in a written notice to proceed by the Jurisdiction and to fully complete the ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION; and to pay liquidated damages for noncompliance with said completion provisions as follows:

Completion of Work

Work on the improvement shall be commenced any time after the after a written Notice to Proceed is issued, no later than **November 15th, 2025**, and shall be completed as stated below. The Notice to Proceed will be issued after the preconstruction conference, which is expected to occur the week of November 11th, 2025.

Work on the project shall start as early as possible. Work on the project shall be substantially complete by May 1st, 2026. Final Completion of all project work, punch-list items, and close-out procedures shall be completed by June 1st, 2026.

Should the contractor fail to complete the work in this timeframe, liquidated damages of **One Thousand dollars ($1,000.00**) per calendar day will be assessed for work not completed within the designated contract term.

IN WITNESS WHEREOF, the Parties hereto have executed this instrument, in triplicate on the date first shown written.

JURISDICTION

By _____
Matt Bemrich, Mayor

(Seal)
ATTEST:

_____
Dawn Siebken, City Clerk

CONTRACTOR

_____
Contractor

By _____
Signature

_____
Title

_____
Street Address

_____
City, State, Zip Code

_____
Telephone

CONTRACTOR PUBLIC REGISTRATION INFORMATION To Be Provided By:

1. All Contractors: The Contractor shall enter its Public Registration Number __ __ __ __ __ - __ __ issued by the Iowa Commissioner of Labor pursuant to Section 91C.5 of the Iowa Code.

2. Out-of-State Contractors:

   A. Pursuant to Section 91C.7 of the Iowa Code, an out-of-state contractor, before commencing a contract in excess of five thousand dollars in value in Iowa, shall file a bond with the division of labor services of the department of workforce development. It is the contractor's responsibility to comply with said Section 91C.7 before commencing this work.

   B. Prior to entering into contract, the designated low bidder, if it is a corporation organized under the laws of a state other than Iowa, shall file with the Engineer a certificate from the Secretary of the State of Iowa showing that it has complied with all the provisions of Chapter 490 of the Iowa Code, or as amended, governing foreign corporations.

NOTE: All signatures on this contract must be original signatures in ink; copies, facsimile, or electronic signatures will not be accepted.

CORPORATE ACKNOWLEDGMENT

State of_____)
) SS
_____County)

On this _____ day of _____, 20____, before me, the undersigned, a Notary Public in and for the State of _____, personally appeared _____ and _____, to me known, who, being by me duly sworn, did say that they are the _____, and _____, respectively, of the corporation executing the foregoing instrument; that (no seal has been procured by) (the seal affixed thereto is the seal of) the corporation; that said instrument was signed (and sealed) on behalf of the corporation by authority of this Board of Directors; that _____ and _____acknowledged the execution of the instrument to be the voluntary act and deed of the corporation, by it and by them voluntarily executed.

_____
Notary Public in and for the State of _____
My commission expires _____, 20 _____

PARTNERSHIP ACKNOWLEDGMENT

State of _____)
) SS
_____County)

On this ____ day of _____, 20 ___, before me, the undersigned, a Notary Public in and for the State of _____, personally appeared _____ to me personally known, who being by me duly sworn, did say that the person is one of the partners of _____, a partnership, and that the instrument was signed on behalf of the partnership by authority of the partners and the partner acknowledged the execution of the instrument to be the voluntary act and deed of the partnership by it and by the partner voluntarily executed.

_____
Notary Public in and for the State of _____
My commission expires _____, 20_____

INDIVIDUAL ACKNOWLEDGMENT

State of _____)
) SS
_____County)

On this _____ day of _____, 20____, before me, the undersigned, a Notary Public in and for the State of _____, personally appeared _____ and _____, to me known to be the identical person(s) named in and who executed the foregoing instrument, and acknowledged that (he) (she) (they) executed the instrument as (his) (her) (their) voluntary act and deed.

_____
Notary Public in and for the State of _____
My commission expires _____, 20_____

LIMITED LIABILITY COMPANY ACKNOWLEDGMENT

State of _____)
) SS
_____County)

On this _____ day of _____, 20____, before me a Notary Public in and for said county, personally appeared _____, to me personally known, who being by me duly sworn did say that person is _____ of said _____, that (the seal affixed to said instrument is the seal of said OR no seal has been procured by the said) _____, and that said instrument was signed and sealed on behalf of the said _____, by authority of its managers and the said _____ acknowledged the execution of said instrument to be the voluntary act and deed of said _____, by it voluntarily executed.

_____
Notary Public in and for the State of_____
My commission expires _____, 20 _____

CONTRACT ATTACHMENT: ITEM 2 - BID ITEMS AND QUANTITIES

This contract is awarded and executed for completion of the work specified in the contract documents for the bid prices tabulated below as proposed by the Contractor in its proposal submitted in accordance with notice to bidders and notice of public hearing. All quantities are subject to revision by the Jurisdiction. Quantity changes that amount to 20% or less of the amount bid shall not affect the unit bid price.

ITEM	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	TOTAL PRICE
	BASE BID				
1.	Select Building Demolition	1	LS	$	$
2.	Existing Building Floor Reinforcing and Wall/Roof Modifications	1	LS	$	$
3.	Existing Masonry Wall Cleaning/Sealing and Vent Installation	1	LS	$	$
4.	Press Box 2nd Story Addition	1	LS	$	$
5.	Stairs	1	LS	$	$
6.	Casework	1	LS	$	$
7.	Gutters and Downspouts	1	LS	$	$
8.	Overhead Netting, Anchorages, Poles, and Foundations	1	LS	$	$
				TOTAL BASE BID:	**$**
	ADD ALTERNATE NO. 1				
9.	Variable Refrigerant Air-Cooled Condensing Unit System (VRF)	1	LS	$	$
				TOTAL ADD ALTERNATE NO. 1:	**$**

TOTAL CONTRACT AMOUNT: _____

SURETY BOND NO. _____

PERFORMANCE, PAYMENT, AND MAINTENANCE BOND

KNOW ALL BY THESE PRESENTS:

That we, _____, as Principal (hereinafter the "Contractor" or "Principal" and _____, as Surety are held and firmly bound unto City of Fort Dodge , as Obligee (hereinafter referred to as "the Jurisdiction"), and to all persons who may be injured by any breach of any of the conditions of this Bond in the penal sum of _____ dollars ($_____), lawful money of the United States, for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, legal representatives and assigns, jointly or severally, firmly by these presents.

The conditions of the above obligations are such that whereas said Contractor entered into a contract with the Jurisdiction, bearing date the _____ day of _____, _____, hereinafter the "Contract" wherein said Contractor undertakes and agrees to construct the following described improvements:

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION, PROJECT #125.0919.01

The project is located at 1628 Nelson Ave, Fort Dodge, IA 50501. The project consists of mobilization, selective site demolition, selective demolition of the existing roof structure and translucent wall panels, second floor addition, roof framing, interior stairs, metal roof system, building electrical, building lighting, mechanical systems, overhead netting system with posts, sidewalk replacement and related improvements.

I will faithfully perform all the terms and requirements of said Contract within the time therein specified, in a good and workmanlike manner, and in accordance with the Contract Documents. Provided, however, that one year after the date of acceptance as complete of the work under the above referenced Contract, the maintenance portion of this Bond shall continue in force but the penal sum for maintenance shall be reduced to the sum of _____DOLLARS ($_____), which is the cost associated with those items shown on the proposal and in the Contract that require a maintenance bond period in excess of one year.

It is expressly understood and agreed by the Contractor and Surety in this bond that the following provisions are a part of this Bond and are binding upon said Contractor and Surety, to-wit:

1. PERFORMANCE: The Contractor shall well and faithfully observe, perform, fulfill, and abide by each and every covenant, condition, and part of said Contract and Contract Documents, by reference made a part hereof, for the above referenced improvements, and shall indemnify and save harmless the Jurisdiction from all outlay and expense incurred by the Jurisdiction by reason of the Contractor's default of failure to perform as required. The Contractor shall also be responsible for the default or failure to perform as required under the Contract and Contract Documents by all its subcontractors, suppliers, agents, or employees furnishing materials or providing labor in the performance of the Contract.

2. PAYMENT: The Contractor and the Surety on this Bond hereby agreed to pay all just claims submitted by persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the performance of the Contract on account of which this Bond is given, including but not limited to claims for all amounts due for labor, materials, lubricants, oil, gasoline, repairs on machinery, equipment, and tools, consumed or used by the Contractor or any subcontractor, wherein

the same are not satisfied out of the portion of the contract price the Jurisdiction is required to retain until completion of the improvement, but the Contractor and Surety shall not be liable to said persons, firms, or corporations unless the claims of said claimants against said portion of the contract price shall have been established as provided by law. The Contractor and Surety hereby bind themselves to the obligations and conditions set forth in Chapter 573 of the Iowa Code, which by this reference is made a part hereof as though fully set out herein.

3. MAINTENANCE: The Contractor and the Surety on this Bond hereby agree, at their own expense:

   A. To remedy any and all defects that may develop in or result from work to be performed under the Contract within the period of 2 years from the date of acceptance of the work under the Contract;

   B. To keep all work in continuous good repair; and,

   C. To pay the Jurisdiction's reasonable costs of monitoring and inspection to assure that any defects are remedied, and to repay the Jurisdiction all outlay and expense incurred as a result of Contractor's and Surety's failure to remedy any defect as required by this section.

4. GENERAL: Every Surety on this Bond shall be deemed and held bound, any contract to the contrary notwithstanding, to the following provisions:

   A. To consent without notice to any extension of time to the Contractor in which to perform the Contract;

   B. To consent without notice to any change in the Contract or Contract Documents, which thereby increases the total contract price and the penal sum of this bond, provided that all such changes do not, in the aggregate, involve an increase of more than 20% of the total contract price, and that this bond shall then be released as to such excess increase; and

   C. To consent without notice that this Bond shall remain in full force and effect until the Contract is completed, whether completed within the specified contract period, within an extension thereof, or within a period of time after the contract period has elapsed and the liquidated damage penalty is being charged against the Contractor.

   D. That no provision of this Bond or of any other contract shall be valid that limits to less than five years after the acceptance of the work under the Contract the right to sue on this Bond.

   E. That as used herein, the phrase "all outlay and expense" is not to be limited in any way, but shall include the actual and reasonable costs and expenses incurred by the Jurisdiction including interest, benefits, and overhead where applicable. Accordingly, "all outlay and expense" would include but not be limited to all contract or employee expense, all equipment usage or rental, materials, testing, outside experts, attorneys fees (including overhead expenses of the Jurisdiction's staff attorneys), and all costs and expenses of litigation as they are incurred by the Jurisdiction. It is intended the Contractor and Surety will defend and indemnify the Jurisdiction on all claims made against the Jurisdiction on account of Contractor's failure to perform as required in the Contract and Contract Documents, that all agreements and promises set forth in the Contract and Contract Documents, in approved change orders, and in this Bond will be fulfilled, and that the Jurisdiction will be fully indemnified so that it will be put into the position it would have been in had the Contract been performed in the first instance as required.

In the event the Jurisdiction incurs any "outlay and expense" in defending itself against any claim as to which the Contractor or Surety should have provided the defense, or in the enforcement of the promises given by the Contractor in the Contract, Contract Documents, or approved change orders, or in the enforcement of the promises given by the Contractor and Surety in this Bond, the Contractor and Surety agree that they will make the Jurisdiction whole for all such outlay and expense, provided that the Surety's obligation under this bond shall not exceed 125% of the penal sum of this bond.

In the event that any actions or proceedings are initiated regarding this Bond, the parties agree that the venue thereof shall be Webster County, State of Iowa. If legal action is required by the Jurisdiction to enforce the provisions of this Bond or to collect the monetary obligation incurring to the benefit of the Jurisdiction, the Contractor and the Surety agree, jointly, and severally, to pay the Jurisdiction all outlay and expense incurred therefor by the Jurisdiction. All rights, powers, and remedies of the Jurisdiction hereunder shall be cumulative and not alternative and shall be in addition to all rights, powers, and remedies given to the Jurisdiction, by law. The Jurisdiction may proceed against surety for any amount guaranteed hereunder whether action is brought against the Contractor or whether Contractor is joined in any such action(s) or not.

NOW THEREFORE, the condition of this obligation is such that if said Principal shall faithfully perform all the promises of the Principal, as set forth and provided in the Contract, in the Contract Documents, and in this Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

When a work, term, or phrase is used in this Bond, it shall be interpreted or construed first as defined in this Bond, the Contract, or the Contract Documents; second, if not defined in the Bond, Contract, or Contract Documents, it shall be interpreted or construed as defined in applicable provisions of the Iowa Code; third, if not defined in the Iowa Code, it shall be interpreted or construed according to its generally accepted meaning in the construction industry; and fourth, if it has no generally accepted meaning in the construction industry, it shall be interpreted or construed according to its common or customary usage.

Failure to specify or particularize shall not exclude terms or provisions not mentioned and shall not limit liability hereunder. The Contract and Contract Documents are hereby made a part of this Bond.

Witness our hands, in triplicate, this _____ day of _____, _____.

Surety Countersigned By:

_____
Signature of Agent

_____
Printed Name of Agent

_____
Company Name

_____
Company Address

_____
City, State, Zip Code

_____
Company Telephone Number

PRINCIPAL:

_____
Contractor

By: _____
Signature

_____
Title

SURETY:

_____
Surety Company

By: _____
Signature Attorney-in-Fact Officer

_____
Printed Name of Attorney-in-Fact Officer

_____
Company Name

_____
Company Address

_____
City, State, Zip Code

_____
Company Telephone Number

NOTE:

1. **All signatures on this performance, payment, and maintenance bond must be original signatures in ink; copies, facsimile, or electronic signatures will not be accepted.**
2. **This bond must be sealed with the Surety's raised, embossing seal.**
3. **The Certificate or Power of Attorney accompanying this bond must be valid on its face and sealed with the Surety's raised, embossing seal.**
4. **The name and signature of the Surety's Attorney-in-Fact/Officer entered on this bond must be exactly as listed on the Certificate or Power of Attorney accompanying this bond.**

NOTICE TO PROCEED

PROJECT: ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION RESTROOM BUILDING EXPANSION

OWNER: CITY OF FORT DODGE, IOWA DATE: _____

TO: Contractor Name: _____

Contractor Address: _____

_____

Work on the project shall start as early as possible. Work on the project shall be substantially complete by May 1st, 2026. Final Completion of all project work, punch-list items, and close-out procedures shall be completed by June 1st, 2026.

Should the contractor fail to complete the work in this timeframe, liquidated damages of **One Thousand dollars ($1,000.00**) per calendar day will be assessed for work not completed within the designated contract term.

On behalf of the City of Fort Dodge

SNYDER & ASSOCIATES, INC

By: _____

Title: PROJECT ENGINEER

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by _____ of

_____ on this the _____ day of _____, 20___.

By: _____

Title: _____

SPECIAL PROVISIONS

SPECIAL PROVISIONS

FOR THE

ROGERS SPORTS COMPLEX- MINI MAJORS CONCESSION
RESTROOM BUILDING EXPANSION

CITY OF FORT DODGE, IOWA

S & A PROJECT NO. 125.0919.01

SPECIAL PROVISIONS

FOR

PART 1 - GENERAL REQUIREMENTS

INDEX

1. DEFINITION AND INTENT

A. The Technical Specifications that apply to the materials and construction practices for this project are defined as follows:

1. The 2025 edition of the Iowa Statewide Urban Specifications for Public Improvements (SUDAS), except as modified by these Special Provisions to the Technical Specifications.

2. Individual technical specifications included in this project manual.

3. References to the City of Fort Dodge Building Code and the adopted version of the International Building Code

4. Contractor shall furnish and install materials and perform all work and services for completed project described in Contract Documents.

2. WORK REQUIRED

A. Work under this contract includes all materials, labor, equipment, transportation, and associated work for the construction of the Rogers Sports Complex-Concession Restroom Building Expansion project, as described in the Official Publication.

B. This project consists of one contract for all work described.

C. Schedule and coordinate the construction work to facilitate timely construction of the improvements.

D. Contractor shall be responsible for the cost of all utilities including, but not

limited to, telephone and electric until project acceptance by the City Council.

3. SALVAGE OF MATERIALS AND EQUIPMENT

A. The City of Fort Dodge retains first right of refusal for retaining any existing materials removed by the contractor during construction.

B. The Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified or indicated to be salvaged. The Contractor shall protect and store items as specified.

C. Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by the Contractor in kind with new items.

4. PLANS AND SPECIFICATIONS

A. The City will furnish 5 sets of plans and specifications to the Contractor after award of the contract. The Contractor shall compensate the City for printing costs for additional copies required.

B. Provide one set of plans and specifications for each foreman and superintendent in charge of each crew on the job.

5. CONSTRUCTION FACILITIES

A. Provide telephone numbers where Contractor's representative can be reached during workdays and on nights and weekends in the event of an emergency.

B. Provide and maintain suitable sanitary facilities for construction personnel for duration of work; remove upon completion of work.

C. Do not store construction equipment, employee's vehicles, or materials on streets open to traffic. Location for storage of equipment by Contractors is subject to approval by the City and Engineer. The Contractor shall provide suitable storage facilities necessary for proper storage of materials and equipment.

D. Provide fence, barricades, and/or workers to prevent access of unauthorized persons to site where work is in progress and to ensure the safety of the public when allowed on site. No trenches shall be left open over night and during non-working hours.

E. Compressed air, sanitary facilities, storage areas, and other services shall be furnished by the Contractor to meet their own requirements and at their own cost.

6. SUBMITTALS

A. Provide construction schedule showing dates of starting and completing various portions of work. The schedule is required at the Preconstruction Meeting and shall be updated for each weekly or bi-weekly construction meeting.

B. The Contractor shall provide a schedule of unit prices for each Lump Sum bid item.

C. Provide at least 3 copies, including additional copies required by Contractor. This information shall be submitted to the Engineer at the preconstruction conference or at least 14 days prior to utilization of the item on this project. Submit the following information for Engineer's review:

1. Testing reports

2. Manufacturer's data for materials that are to be permanently incorporated into the project.

3. Details of proposed methods of any special construction required.

4. Submit purchase orders and subcontracts without prices.

5. Certificate of Insurance to the Engineer which includes the Jurisdiction and Engineer as additional insured.

6. Such other information as the Engineer may request to ensure compliance with contract documents.

7. STANDARDS AND CODES

A. Construct improvements with best present day construction practices and equipment.

B. Conform with and test in accordance with applicable sections of the following standards and codes.

1. American Association of State Highway and Transportation Officials (AASHTO).

2. American Society for Testing and Materials (ASTM).

3. Iowa Department of Transportation Standard Specifications (Iowa DOT).

4. American National Standards Institute (ANSI).

5. American Water Works Association (AWWA).

6. American Welding Society (AWS).

7. Federal Specifications (FS).

8. Iowa Occupational Safety and Health Act of 1972 (IOSHA).

9. Manual of Accident Prevention in Construction by Associated General Contractors of America, Inc. (AGC).

10. SUDAS Standard Specification, 2025 Edition

11. Iowa DOT Standard Specifications, Most Recent Edition

12. Iowa DOT Materials I.M.s, Most Recent Edition

13. Standards and Codes of the State of Iowa and the ordinances of the City of Fort Dodge, Iowa.

14. Other standards and codes which may be applicable to acceptable standards of the industry for equipment, materials and installation under the contract.

8. MATERIALS TESTS

A. Contractor shall employ and pay for services of an independent testing laboratory for test required to show compliance materials and specifications. Provide transportation of all samples to laboratory. Selection of testing laboratory subject to approval of the Engineer.

B. Coordinate all material testing with the Engineer.

C. Provide transportation of all samples to the laboratory.

D. Do not ship materials to the project site until laboratory tests have been furnished showing compliance of materials with specifications.

E. Provide gradation and materials certifications for all granular materials.

F. Certify that materials and equipment are manufactured with applicable specifications.

G. Any Materials not in compliance with these specifications will be ordered off the site(s) and compensation for transportation and/or materials will not be paid.

9. FIELD TESTS

A. Field testing is incidental to construction and will be completed by an independent testing laboratory retained by the Contractor and approved by the Engineer. Testing shall meet the requirements of SUDAS.

B. Coordinate all field testing with the Engineer. The Engineer will observe all tests.

C. The Contractor is responsible for meeting the specified testing requirements in the SUDAS for construction relating to Divisions 2, 3, 4, 6, 7, and 9 of said specification, if deemed necessary for the completion of the work specified.

1. Trench Backfill: Section 3010, Part 2 and Section 3010, Part 3.06 and Special Provisions of these specifications

a. Compact trench and structure backfill to not less than 95% of maximum Standard Proctor Density in a street or road right-of-way and under any granular or paved surfaces.

b. Compact to not less than 90% maximum Standard Proctor Density in all other areas.

c. Compaction requirements remain in effect during cold weather.

D. If test results do not meet those specified, the Contractor shall make necessary corrections and repeat testing to demonstrate compliance with the specifications. Contractor shall pay all costs for retesting.

10. CONSTRUCTION STAKING

A. Construction staking will be provided by the Contractor for construction of the netting system. Please contact Brian Foltz at (515) 230-0447 at Snyder & Associates, Inc., for a construction staking proposal.

11. MEASUREMENT AND PAYMENT

A. Contract unit or lump sum prices are full compensation for furnishing all materials, equipment, tools, transportation, and labor necessary to construct and complete each item of work as specified. No separate payment will be made for work included in this project. All other items of work are incidental to construction.

B. Please see the following Base Bid items included in the project:

1. Bid Item No. 1- Select Building Demolition (Lump Sum)

2. Bid Item No. 2- Existing Building Floor Reinforcing and Wall/Roof Modifications (Lump Sum)
3. Bid Item No. 3- Existing Masonry Wall Cleaning/Sealing and Vent Installation (Lump Sum)
4. Bid Item No. 4- Press Box 2nd Story Addition (Lump Sum)
5. Bid Item No. 5- Stairs (Lump Sum)
6. Bid Item No. 6- Casework (Lump Sum)
7. Bid Item No. 7- Gutters and Downspouts (Lump Sum)
8. Bid Item No. 8- Overhead Netting, Anchorages, Poles, and Foundations (Lump Sum)

C. Please see the following Alternate Bid Item description for additional work to be included in the project if authorized by the City:

Alternate Bid Item No. 1- Variable Refrigerant Air-Cooled Condensing Unit System (VRF) (Lump Sum)

If selected by the Owner, the Contractor shall furnish and install the VFR system and all associated appurtenances, including electrical connections, condensing unit, fan coil units, etc. as per the mechanical plan sheets. Please refer to specification Division 22 'Plumbing', Division 23 'Heating, Ventilating, and Air Conditioning' and Division 26 'Electrical' for additional information. If the alternate bid is not selected, no equipment, materials or work associated with the VRF system would be performed.

12. INCIDENTAL CONTRACT ITEMS

The following list includes major items that are incidental to the project and will not be paid for as separate bid items. Other items may be designated as incidental under certain bid items.

- Cold weather protection for PCC Pavement
- Connection of existing drain line to storm sewer
- Construction fencing
- Coordination and cooperation with utility companies
- Coordination and cooperation with the City of Fort Dodge
- Curb and pavement backfill
- Dewatering and handling storm water flow during construction
- Dust control measures
- Engineering fabric
- Excavation, verification, and protection of existing utilities
- Finish grading
- Granular backfill and bedding for storm sewer installation
- Granular surfacing removal (unless included as a specific contract item)
- Handling storm water flow during construction

- Locate of existing utilities, potholing if necessary
- Maintaining garbage and utility service to users
- Maintenance and watering for seeding and sodding
- Material & Field testing
- Monitoring weather conditions
- Porous backfill and fabric for subdrain
- Protection of hydrants and valves
- Protection of existing utilities and light poles
- Protection of existing trees and plantings not removed
- Repair of field tiles, if encountered
- Saw-cutting pavement at removal limits
- Site cleanup/surface restoration and seeding
- Temporary sheeting and shoring

SPECIAL PROVISIONS

FOR

PART 2 - SPECIAL CONDITIONS

INDEX

1. INTENT

A. To supplement the provisions of the GENERAL REQUIREMENTS by outlining special conditions applicable to project.

2. LOCATION

A. Work is located on City owned property in the City of Fort Dodge, Iowa.

3. SITE AVAILABILITY AND WORK AREA LIMITS

A. The Contractor may commence work any time starting November 12, 2025. The Contractor shall prosecute the work diligently and continuously to completion.

B. Contractor shall coordinate construction activities and work schedule with the Engineer, City of Fort Dodge, and any adjacent construction operations located within the project area.

C. The Contractor is required to coordinate and maintain access to the property and other field areas during construction.

D. Once construction work commences, confine movements of equipment and personnel, excavation, materials, and all other construction operations within construction limits as shown on the construction drawings.

E. The Contractor is expected to provide adequate personnel and equipment to perform work within specified time of construction.

F. Install and maintain orange safety fence around all open trenches or open structures when left unattended. No trenches shall be left open during non-working hours and at night.

G. Provide surface restoration and clean up as construction progresses.

H. The Contractor shall limit his work operations to the following hours as follows:

Monday through Friday – 7:00 a.m. to 9:00 p.m.
Saturday – 7:00 a.m. to 9:00 p.m.
Sunday – 7:00 a.m. to 6:00 p.m.

4. ORDER OF CONSTRUCTION

A. Provide Engineer with proposed schedule of construction showing dates of starting and completing various portions of work. This schedule is required at the Preconstruction Meeting and shall be updated for each construction meeting.

B. The Contractor is required to submit an updated and accurate construction schedule with each partial pay application submittal. Partial pay applications will not be processed until said construction schedule is received by the Engineer.

5. INTERRUPTIONS TO SERVICE

A. Utility service shall remain in substantially continuous operation during construction except during periods of notified service interruption.

B. Perform work which will interrupt utility service only at times approved by Engineer; hold interruptions of service to a minimum.

6. SERVICE FACILITIES

A. Compressed air, sanitary facilities, storage areas, and other services shall be furnished by Contractor to meet their own requirements and at their own cost. All facilities shall be confined to the City-owned property within the construction limits, as defined and approved by the City.

7. STORAGE OF MATERIALS AND EQUIPMENT

A. Secure site for storage of materials and equipment. Do not store within street rights-of-way or public areas unless allowed by Owner.

B. Store materials and equipment in manner which will preserve their quality and fitness.

8. CONSTRUCTION FACILITIES BY CONTRACTORS

A. Provide office telephone and cell phone numbers of contractor representative for weekend, holiday, and evening problems referral.

B. Provide fence, barricades, and/or workers to prevent access of unauthorized persons to site where work is in progress and to ensure the safety of the public when allowed on site.

9. EMPLOYMENT PRACTICES

A. Contractor, or his/her subcontractors, shall not employ any person whose physical or mental condition is such that their employment will endanger the health and safety of themselves or others employed on the project.

10. APPROVAL OF MATERIALS

A. All materials to be supplied by the Contractor shall have prior approval by the Engineer as to suppliers, components, proportions, gradations, sources, and delivery methods.

B. Submit to the Engineer certified statements of materials electronically; certify that the materials to be used on this project meet the specifications so outlined. Any deviations must be pointed out and will be subject to the approval of the Engineer before incorporation into this project.

C. Any materials not in compliance with these specifications will be ordered off the site(s) and compensation for transportation and/or materials will not be paid.

11. PROJECT ACCEPTANCE

A. All seeding and surface restoration shall meet the following requirements prior to project acceptance:

1. All requirements for the completed installation, watering, and maintenance have been provided.

2. Seeded areas shall be growing and in a well-established condition without eroded areas, bare spots, free of weeds, undesirable grass species, and disease.

3. Clean-up operations are completed.

4. See specification section 32 92 00 for additional information.

B. All streets, sidewalks, and recreational trails located within the project limits shall be cleaned and free of mud, dirt, and other debris.

C. The punch list items shall be completed prior to project acceptance.

D. Grass located within the project limits that is longer than 12-inches shall be mowed prior to project acceptance.

12. EXISTING UTILITIES

A. Location of utility lines, mains, cables and appurtenances shown on plans are from information provided by utility companies and records of the Owner.

B. Prior to construction, contact all utility companies and have all utility lines and services located. The Contractor is responsible for excavating and exposing underground utilities in order to confirm their locations ahead of the work.

C. Contractor is solely responsible for damage to utilities or private or public property due to utility disruption.

D. The Contractor shall notify utility company immediately if utility infrastructure is damaged during construction.

E. Utility companies will relocate utility infrastructure in direct conflict with line and grade of the work during construction. Support and protect all utilities that are not moved.

F. Utility services are not generally shown on plans; protect and maintain services during construction. Notify Owner and affected property owners 48 hours prior to any planned utility service interruptions.

G. If utility work does occur during the construction period, work schedules from the contractor and from the utility companies will be submitted to the Engineer for coordination to obtain mutual acceptable schedules, if possible.

H. Existing utilities shall remain in substantially continuous operation during construction. Select the order and methods of construction that will not interfere with the operation of the utility systems. Interrupt utility services only with

approval of Owner and Engineer.

I. No claims for additional compensation or time extensions will be allowed to the Contractor for interference or delay caused by utility companies.

J. Contractor shall coordinate their operations with private construction companies on adjacent properties.

13. PROJECT SUPERVISION

A. The Prime Contractor shall be always present at the construction site. It is imperative that the construction operations are always supervised by a qualified superintendent or other designated, qualified representative. The superintendent or representative must be duly authorized to receive and execute instructions, notices, and written orders from the Engineer.

B. Issues that arise during construction relating to traffic control, construction staging, resident notifications, mail service, garbage service, access to residences, etc. are the responsibility of the Prime Contractor.

C. A meeting with the Contractor, Engineer and Owner will be held at the project site before construction to coordinate the construction work.

D. Refer to Division 1 – General Provisions and Covenants, Section 1080 – Contractual Provisions, Prosecution and Progress, Section 1.10 Contractor's Employees, Methods and Equipment for additional requirements.

14. CONSTRUCTION LIMITS

A. Confine the construction operations within the construction limits shown on the plans, consisting of public right-of way and temporary easements.

B. Do not store equipment, vehicles, or materials within the right-of-way of any streets open to traffic at any time without approval of the City. Do not store equipment, vehicles, or materials within temporary construction easement areas.

C. Areas disturbed outside of construction limits shall be restored at the contractor's expense to the satisfaction of the Jurisdiction. Contractor shall protect trees, fences, sidewalks, and landscaping within the construction limits not marked as remove.

D. Contractor shall demonstrate that sufficient manpower and equipment is scheduled for construction work to maintain a timely and orderly construction.

15. DISPOSAL

A. Remove from project site and dispose of trees, shrubs, vegetation, excess soil

excavation, rubbish, concrete, granular materials and other materials encountered as shown on plans and as specified.

B. Dispose of materials in accordance with applicable laws and ordinances. Disposal sites are subject to the review and approval of the Engineer.

1. Burning of brush and other debris is not permitted. Contractor responsible for selecting disposal site.

2. Dispose of broken concrete, asphalt, granular material, rubble, excess or unsuitable excavated material. Contractor is responsible for selecting disposal site.

3. Cooperate with all applicable City, State and Federal agencies concerning disposal of materials.

4. The Owner has the first right to any excess materials from construction.

16. EROSION PROTECTION

A. Comply with IOWA URBAN STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS, Section 9040 except as modified herein.

B. Comply with soil erosion control requirements of Iowa Code and local ordinances. Protect against erosion and dust pollution on the project site and any off-site deposit area used for this project.

C. Provide erosion control measures necessary to protect against siltation and erosion or flow of storm water. Maintain storm sewer and other drainage systems throughout the construction period.

D. Use silt fences, ditch checks, and other means at all drainage courses and swales to protect against siltation and erosion.

E. Furnish, install, maintain, clean, repair, and remove silt fence and silt basins at intakes and inlets and as shown on plans and as directed by Engineer.

F. Contractor fully liable for all damages to public or private property caused by their action or inaction in providing for handling of storm water flow during construction.

G. As construction progresses, sodding, seeding, and mulching is required in those segments of the corridor that become available to do so. The Contractor shall not wait until all grading and paving operations are completed before commencing final surface restoration.

H. The Contractor shall anticipate multiple mobilizations to complete seeding, sodding, mulching, and surface restoration operations as areas of the project corridor become available to do so.

17. DEWATERING

A. Perform all construction work in dry conditions.

B. Submit dewatering methods to the Engineer for review. Obtain the Engineer′s approval on methods prior to construction.

C. Groundwater levels are subject to variation. No additional compensation will be permitted due to high groundwater conditions.

D. If excavation encounters only cohesive soils with no wet sand seams or layers, it may be possible to control water seepage by draining groundwater to temporary construction sumps and pumping it outside the perimeter of the excavation.

E. Do not pump water from open excavation in sand and gravel below the natural ground water level.

F. Maintain water levels 2 feet or more below the bottom of excavations in saturated cohesionless (sand and/or gravel) soils to prevent upward seepage, which could reduce subgrade support.

1. Install dewatering system (well points or shallow wells) when working in cohesionless soils.

2. Costs of installing and operating dewatering system are incidental.

G. Provide for handling surface water encountered during construction.

1. Prevent surface water from flowing into excavation, remove water as it accumulates.

2. Divert storm sewer flow around areas of construction.

3. Do not use sanitary sewers for the disposal of trench water.

H. Backfill pipe and structures prior to stopping dewatering operations. Do not lay pipe or construct concrete structures on excessively wet soils.

I. The costs of handling both surface water and groundwater are incidental.

18. TEMPORARY FENCES

A. Install temporary fencing around open excavations or material storage areas and as directed by Engineer to prevent access of unauthorized persons to construction areas.

B. Provide orange plastic mesh safety fence with a nominal height of 48". Support fence securely on driven posts in vertical position without sagging.

1. Materials: Iowa DOT Section 4188.03.

2. Use unless required otherwise.

C. Temporary fencing installed around open excavations or material storage areas is incidental to construction and will not be measured for payment.

D. Remove temporary fencing upon completion of construction.

19. RESPONSIBILITY OF CONTRACTOR

A. Supervision of the work.

B. Protection of all property from injury or loss resulting from construction operations.

C. Replace or repair objects sustaining any such damage, injury or loss to satisfaction of Owner and Engineer.

D. Cooperate with Owner, Engineer, and representatives of utilities in locating underground utility lines and structures. Incorrect, inaccurate or inadequate information concerning location of utilities or structures shall not relieve the Contractor of responsibility for damage thereto caused by construction operations.

E. Keep cleanup current with construction operations.

F. Comply with all Federal, State of Iowa, and City of Fort Dodge, Iowa laws and ordinances.

20. CONCRETE PAVEMENT (PCC)

A. Comply with IOWA URBAN STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS, Sections 7010 and 7030, except as modified herein.

B. Coarse Aggregate: USE CLASS 3 DURABILITY LIMESTONE, IDOT, SECTION 4115.04.

C. Mix Design: IDOT C-4 mix shall be used for all concrete as specified on the construction drawings.

D. Restore core holes by tamping non-shrink cement grout into hole; finish and texture surface.

E. The use of maturity testing as per IDOT IM 383 will be allowed with a minimum of one set of cylinders made each day to verify compressive strength.

F. Each truck load of concrete must be identified by an acceptable plant charge ticket showing plant name, contractor, project name, date, quantity, class, and time batched.

G. Provide cold weather protection as specified for temperature below 25 degrees F. for all concrete placed after November 15.

H. Special care should be taken when forming at intersections so that the profiles and elevations shown on the cross sections, plan and profile, and intersection detail sheets are obtained. Short lengths of forms or flexible forms may be necessary at these locations.

I. Maturity testing shall be utilized to expedite street opening.

J. Contractor to provide all materials testing except for slump and air entrainment testing. Slump and air entrainment testing will be provided by the City.

21. SURFACE RESTORATION

A. Finish grade all disturbed areas to smooth, uniform lines without large clods, lumps, or debris. Grade for positive drainage.

B. Prepare the finished surface for seeding. Provide and place additional clean topsoil on any disturbed areas that, in the opinion of the Engineer, are lacking in natural topsoil. Provide organic material that is free of vegetation, rubble or other debris.

C. All areas to be seeded shall be prepared, fertilized, seeded, mulched, staked, watered, maintained, and warranted in accordance with specification Section 32 92 00.

D. Any areas disturbed by construction that are outside of the construction limits shall be repaired and restored at the Contractor's expense. No extra payment will be allowed for surface restoration on these areas.

E. Install silt fences at the locations directed by the Engineer during construction and nay locations needed to prevent soil erosion.

F. Seeding work completed after the specified seeding dates in specification Section

32 92 00 shall be at the risk of the contractor to maintain.

END OF SECTION

TECHNICAL SPECIFICATIONS

SECTION 02 4119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 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.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

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

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

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

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

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

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

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

   1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 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.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs or video and templates.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. Arrange to shut off utilities with utility companies.
   3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 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.

   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.

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.

   1. Strengthen or add new supports when required during progress of selective demolition.

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

3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. 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.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. 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.
5. Maintain fire watch during and for at least 6 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. 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. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. 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.
4. Comply with requirements specified in Section 017400 "Cleaning and Waste Management."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. 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.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Remove: See plans

END OF SECTION 02 4119

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 REFERENCE STANDARDS

A. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.

B. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

C. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

D. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.

E. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.

F. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012a.

G. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2010a.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

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.

1.0 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. 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 construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Curing compounds.
   6. Floor and slab treatments.
   7. Bonding agents.
   8. Adhesives.
   9. Joint-filler strips.
   10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. 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.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
   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.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
   1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301 (ACI 301M).
   2. ACI 117 (ACI 117M).

2.02 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. Structural 1, B-B or better; mill oiled and edge sealed.

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

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

2.03 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as drawn steel wire into flat sheets.

2.04 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. 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.

2.05 CONCRETE MATERIALS

A. 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.

B. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type IL
   2. Fly Ash: ASTM C 618, Class F or C.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Water: ASTM C 94/C 94M and potable.

2.06 CURING MATERIALS

A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
   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. BASF Corporation; Construction Systems.
      b. Dayton Superior.
      c. Euclid Chemical Company (The); an RPM company.
      d. W. R. Meadows, Inc.

2.07 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 7174, preformed closed-cell polyolefin expansion joint filers with “tear-off” strips. Joints must be primed with as required by the sealant manufacturer. Acceptable manufacturers and products:
   1. Reflectix; Reflectix Expansion Joint.
   2. Sealed Air Corp.; Cellu-Cushion Exp 200

B. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

C. 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 I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.08 REPAIR MATERIALS

A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150/C 150M, 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 (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 4000 psi. Insert strength at 28 days when tested according to ASTM C 109/C 109M.

2.09 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 (ACI 301M).
   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.

C. 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.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Normal-weight concrete.
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.

2. Maximum W/C Ratio: 0.40.
3. Slump Limit: 4 inches (100 mm), 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

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

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

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.

3.02 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods and embeds, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.03 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 (10 deg C) 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 support weight of concrete in place until concrete has achieved at least 70 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. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

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

3.04 SHORING AND RESHORING INSTALLATION

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

B. 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.

3.05 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. 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.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

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

E. 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.

3.06 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
   3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least onefourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
   3. 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 (150 mm) 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.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. 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 disturbslab surfaces before starting finishing operations.

3.08 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. 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 concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.09 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. 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.

C. 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.

D. Broom Finish: Apply a broom finish to exterior concrete 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 Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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 inplace construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) 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. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. 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 remainder of 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. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
    1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water 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 (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
    3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
    1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
    2. After concrete has cured at least 14 days, correct high areas by grinding.
    3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
    4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
    5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor

elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) 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 (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

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. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. 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/C 172M 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    a. When frequency of testing provides 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.
3. Slump: ASTM C 143/C 143M; one test at point of placement 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.
4. Air Content: ASTM C 231/C 231M, 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.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. 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 (3.4 MPa).
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. 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 Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 3000

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.

B. Rough opening framing for doors, windows, and roof openings.

C. Sheathing.

D. Preservative treated wood materials.

1.02 RELATED REQUIREMENTS

A. Section 06 1753 - Shop-Fabricated Wood Trusses.

1.03 REFERENCE STANDARDS

A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2012.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.

F. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.

G. PS 20 - American Softwood Lumber Standard; 2010.

H. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements and required design values as indicated on structural dwgs..

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER

A. Grading Agency: Western Wood Products Association (WWPA).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Stud Framing (2 by 2 through 2 by 6):
   1. Refer to structural drawings for minimum stresses.
   2. Structural Framing: Hem Fir Stud Grade or better
   3. Stud Framing: Hem-Fir Stud Grade or better
   4. S4S

E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2.
   2. Boards: No. 2.

2.03 CONSTRUCTION PANELS

A. Wood structural panels shall conform to the following requirements:
   1. US Products Standard PS 1 for construction and industrial plywood.
   2. US Products PS 2 performance standard for wood based structural-use panels.
   3. APA PRP-108 Performance Standards

B. Roof and Wall Sheathing:
   1. DOC PS 1, Exterior, APA Rated sheathing.
   2. Nominal Thickness: 5/8 inch.
   3. Span Rating: 24/0.
   4. Edge Profile: Square edges
   5. Plywood clips

C. Floor Sheathing:
   1. DOC PS 1, Exterior, APA Rated sheathing.
   2. Nominal Thickness: ¾ inch.
   3. Span Rating: 32/16.
   4. Edge Profile: Tongue and groove

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   2. Nails and staples shall conform to the requirements of ASTM F 1667 and NER-272.
   3. Nails shall be identified labels (attached to their containers) that show the manufacturer's name, NES Report, nail shank diameter, and length.
   4. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity, exterior, and preservative-treated wood locations, unfinished steel elsewhere.
   5. Anchors: Toggle bolt type for anchorage to hollow masonry.
   6. Power-Driven Fasteners: NES NER-272.

B. Bolts and Lag Screws:
   1. Conform to ANSI/ASME Standard B18.2.1
   2. Bolt holes shall be at least a minimum 1/32" and no more than 1/16" larger than the bolt diameter
   3. All bolts and lag screws shall be installed with standard cut washers.
   4. All A307 bolts shall have cut threads.
   5. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M

C. Metal Framing Connectors:
   1. Manufacturer:
      a. Simpson Strongtie

b. Substitutions; obtain prior approval for alternate manufacturer. Submit manufacturer's published testing data and load capacity for engineer's review and written approval.

2. Refer to structural drawings for framing connector types.
3. Finish:
   a. Interior locations; Galvanized-Steel Sheet, Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
   b. Exterior locations, at preservative treated material, high humidity areas, and as indicated; hot dipped galvanized, minimum G185 galvanizing per ASTM A653/A653M.

D. Sill Gasket on Top of CMU Bearing Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

E. Water-Resistive Air Barrier: As specified in Section 07 2500.

F. Anchor Bolts: Refer to structural drawings.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
      a. (CA) Copper Azole.Micronized.
      b. With manufacturer's integral water repellent
      c. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      d. Treat lumber exposed to weather.
      e. Treat lumber in contact with roofing, flashing, or waterproofing.
      f. Treat lumber in contact with masonry or concrete.
      g. Treat lumber less than 6 inches above grade.
      h. Treat lumber in other locations as indicated.
   2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
      a. (CA) Copper Azole.Micronized.
      b. With manufacturer's integral water repellent
      c. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      d. Treat plywood in contact with roofing, flashing, or waterproofing.
      e. Treat plywood in contact with masonry or concrete.
      f. Treat plywood less than 6 inches above grade.
      g. Treat plywood in other locations as indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Install sill gasket under wood plate at top of CMU bearing walls; puncture gasket cleanly to fit tightly around bolts.

B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
   4. Refer to structural drawings for additional/more stringent requirements.

F. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices .

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by AFPA Wood Frame Construction Manual and 2009 IBC.

E. Install horizontal spanning members with crown edge up.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

G. Cutting, notching, or drilling of members shall be only as detailed or approved by the structural engineer.

H. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Roof, wall and floor sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. At long edges use sheathing clips where joints occur between roof framing members.
   2. Nail panels to framing per schedule on drawings; staples are not permitted.
   3. Space panels 1/8" apart at edges and ends.
   4. Refer to structural for additional requirements.

3.06 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 7419.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 1000

SECTION 06 1753

SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated wood trusses for floor reinforcing and roof framing.

B. Bridging, bracing, and anchorage.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Material requirements for blocking, bridging, plates, and miscellaneous framing.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

B. TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction; 2007 and errata.

C. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; 1989.

D. BCSI 1 - Building Component Safety Information Booklet: The Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses; joint publication of the Truss Plate Institute and the Wood Trust Council of America; 2006.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, metal bracing components, and handling and erection requirements.

C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
   1. Include identification of engineering software used for design.
   2. Provide shop drawings stamped or sealed by design engineer.
   3. Submit design calculations.
   4. Provide species information pertaining to stress, size, and stress grade
   5. Indicate truss geometry including pitch, span, camber, overall configuration and member spacing for each truss type.
   6. Indicate type, size material, finish, design values, and locations of all metal plate connectors.
   7. Indicate all splice, bearing, loading and anchorage details.
   8. Provide engineering information including: design analysis, section modulus, allowable stresses, stress diagrams & calculations, and other pertinent design information.
   9. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
   10. Seal all drawings and calculations to indicated Engineer of Record licensed to practice in the State of Iowa.

1.05 QUALITY ASSURANCE

A. Truss Design, Fabrication, and Installation: In accordance with TPI 1, TPI DSB-89, BCSI 1, and IBC Section 2303.4.

B. Designer Qualifications:
   1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive analysis by a qualified professional engineer.

C. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle and erect trusses in accordance with TPI BCSI 1.

B. Store trusses in vertical position resting on bearing ends.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.01 TRUSSES

A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
   1. Connectors: Steel plate.

2.02 MATERIALS

A. Lumber:
   1. Grades and Species:
      a. Component materials are to be provided and graded under the latest editions and supplements of nationally accepted grading rules and shall comply with all stress requirements of those rules.
      b. Selection of wood species and material specifications shall be consistent with the structural design of the overall wood component unless more stringent requirements are indicated on the Structural Drawings.
         1) Douglas fir: Standard Grading and Dressing Rules No. 15, as published by West Coast Lumbermen's Association.
         2) Southern pine: Standard Grading Rules for Southern Pine Lumber, as published by Southern Pine Inspection Bureau.
   2. Moisture Content: Between 7 and 19 percent.
   3. Lumber fabricated from old growth timber is not permitted.

B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G60/Z180 coating; die stamped with integral teeth; thickness as required, but not less than 0.036 inch (0.9 mm) thick.

C. All attachments, fasteners, connection plates, etc. provided by the fabricator are to be hot-dip galvanized, with G60/Z180 coating.

D. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.03 ACCESSORIES

A. Fasteners: Hot-dip galvanized steel, type to suit application.

2.04 COMPONENT DESIGN & FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Mechanical/Electrical Coordination:
   1. General, Mechanical, Electrical, and Plumbing Contractor(s) shall coordinate with truss supplier/designer to include all requirements for their systems, including:
      a. Weight/support of equipment for concentrated loads on trusses.
      b. Size of penetrations through framing.

C. Provide trusses in geometric configurations as shown on the drawings with all required modifications from the manufacturers' standard configurations.

D. Fabricate individual members and component assemblies accurately and consistent with structural design requirements. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

E. Camber trusses for dead load deflection. Live load deflection limit = L/360. Total load deflection limit = L/240.

F. Truss manufacturer to identify and design tie-down bracket between each truss and top plate of stud walls.

G. Fabricate trusses in sections if required for transportation to the jobsite. Indicate all pickup locations on the shop drawings.

H. Attach tags to all truss members with component numbers matching erection drawings.

I. Brace wood trusses in accordance with TPI DSB-89 and BCSI 1.

J. All pre-engineered construction shall strictly comply with designer's plans and specifications.

K. Alternate truss framing system may be submitted for approval. Acceptable alternates must provide for same minimum load capacity and deflection characteristics as system shown, and must include certifications and calculations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that supports and openings are in place and are braced and secured.

3.02 ERECTION

A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1.

B. Wood construction shall conform to conventional construction provisions of the 2009 International Building Code unless noted otherwise.

C. Set members level and plumb, in correct position.

D. Contractor is responsible for field erection of pre-engineered trusses including erection bracing, permanent bracing, and bridging if required.

E. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

F. Do not field cut or alter structural members without approval of Engineer. Do not cut, drill, notch, or remove truss members.

G. All erection bracing and permanent bracing shall be installed and all components permanently fastened per manufacturer's design before the application of any loads.

H. Frame openings between trusses with lumber in accordance with Section 06 1000.

I. Coordinate placement of decking with work of this section.

J. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

K. Replace wood trusses that are damaged or do not meet requirements.

3.03 TOLERANCES

A. Install wood trusses within installation tolerances in TPI 1.

END OF SECTION 06 1753

SECTION 081416

FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-core five-ply flush wood doors and transom panels for opaque finish.
   2. Wood door frames.

B. Related Requirements:

   1. Section 064023 "DOOR HARDWARE

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Solid-core five-ply flush wood doors
   2. Wood door frames.

B. Product Data Submittals: For each product, including the following:

   1. Door core materials and construction.
   2. Door edge construction
   3. Door face type and characteristics.
   4. Door trim for openings.
   5. Door frame construction.
   6. Factory priming specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

   1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
   2. Door elevations, dimension and locations of hardware,
   3. Details of frame for each frame type, including dimensions and profile.
   4. Dimensions and locations of blocking for hardware attachment.
   5. Dimensions and locations of mortises and holes for hardware.
   6. Clearances and undercuts.
   7. Doors to be factory primed and application requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.4 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty Period for Solid-Core Interior Doors: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain flush wood doors from single manufacturer.

2.2 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS

A. Interior Doors, Solid-Core Five-Ply
1. Performance Grade: ANSI/WDMA I.S. 1A [Standard Duty]
2. Faces: [Any closed-grain hardwood of mill option]

3. Exposed Vertical and Top Edges: Any closed-grain hardwood.

4. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-1 particleboard.

5. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3 WOOD DOOR FRAMES

A. Interior Door Frames:
   1. ANSI/WDMA I.S. 1A Quality Grade: [Premium]
   2. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
   3. Cut: [Plain sliced/plain sawn]
   4. Profile: [As indicated on Drawings].
   5. Construction: Solid lumber

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

   1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

2.5 FACTORY PRIMING

A. Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

   1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see [Section 087100 "Door Hardware."]

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

   1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches
   2. Anchor frames to anchors or blocking built in or directly attached to substrates.

      a. Secure with countersunk, concealed fasteners and blind nailing.

b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.

1) For factory-finished items, use filler matching finish of items being installed.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416

SECTION 08 5313

VINYL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl windows.

1.2 DEFINITIONS

A. Combination Assemblies: An assembly formed by a combination of two or more separate fenestration products whose frames are mulled together utilizing a combination mullion or reinforcing mullion.

B. Combination Mullions: A horizontal or vertical member formed by joining two or more individual fenestration units together without a mullion stiffener.

C. Reinforcing Mullions: A horizontal or vertical member with an added continuous mullion stiffener and joining two or more individual fenestration units along the sides of the mullion stiffener.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site]

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate interrelationship of vinyl windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.

B. Shop Drawings:

1. Plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Product Schedule: For vinyl windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of vinyl window, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Field Quality-Control Reports: For vinyl windows.

C. Qualification Statements: For manufacturer and Installer.

D. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating vinyl windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: Authorized representative who is trained and approved by vinyl window manufacturer.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace vinyl 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, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Five years from date of Substantial Completion.
b. Glazing Units: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain vinyl windows from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: FGIA or WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: [CW]
2. Mulled Window Systems: Evaluate and rate combination assemblies as single systems as determined by AAMA 450 in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 requirements.

C. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor): As determined in accordance with NFRC 100:
   a. Operable Windows: Not more than [**0.55 Btu/sq. ft. x h x deg F**

D. Outdoor-Indoor Transmission Class (OITC): Rated for not less than [22] OITC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E1332.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone [1] for [basic] protection.
1. Small-Missile Test: For glazing located more than [**30 ft.** above grade.

2.3 VINYL WINDOWS

A. Provide manufacturer's standard vinyl window assemblies consisting of frames, sashes, glass, hardware, fasteners, and all components and accessories as required for a complete installation.

B. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Double hung.

C. Frames and Sashes: Impact-resistant, UV-stabilized PVC complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Finish: Integral color, [white]
2. Gypsum Board Returns: Provide at interior face of frame.

D. Windborne-Debris-Impact-Resistant Insulating-Glass Units: ASTM E2190, with two lites and complying with impact-resistance requirements in "Performance Requirements" Article.

1. Exterior Lite: ASTM C1036, Type 1, Class 1, q3.

    a. Tint: [Clear]

2. Interior Lite: ASTM C1172, clear laminated glass with two plies of float glass.

    a. Float Glass: [As required by performance requirements indicated].
    b. Interlayer Thickness: [As required by performance requirements indicated]

3. Filling: Fill space between glass lites with [air]
4. Low-E Coating: [Pyrolytic on second surface] "Glazing System" Paragraph below refers to the method by which the glazing unit (glass) is retained within the window sash or frame.

E. Glazing System: [Manufacturer's standard factory-glazing system that produces weathertight seal]

F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: [As indicated by manufacturer's designations]
2. Limit Devices: [Concealed friction adjustor, adjustable stay bar]

G. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.

H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Avoid exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

J. Mullions: Provide combination and reinforcing mullions and cover plates matching window units, complete with anchors for support to structure. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide reinforcing mullions and cover plates capable of withstanding design wind loads of window units.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: [Full, outside for double-hung] sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
2. Finish for Exterior Screens: [Baked-on organic coating in color selected by Architect from manufacturer's full range].

C. Glass-Fiber Mesh Fabric: [**18-by-14** mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: charcoal or black

2.5 FABRICATION

A. Fabricate vinyl windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze vinyl windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Hardware: Mount hardware through double walls of vinyl extrusions or provide corrosion-resistant reinforcement.

E. Window Assemblies: Provide window units in configuration indicated on Drawings. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

1. Combination and reinforcing mullions with interior and exterior trim.
2. Interior and exterior extension and trim.
3. Head and seat boards.
4. Top and bottom plywood platforms.
5. Support brackets.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, air and weather barriers, and other built-in components to ensure weathertight window installation.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 FIELD QUALITY CONTROL

A. Test and Inspections:

1. Windows will be considered defective if they do not pass tests and inspections.

3.4 ADJUSTING

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

3.5 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION 08 5313

SECTION 08 7100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Interior Swinging doors.

B. Related Requirements:
1. Section 081416 – “FLUSH WOOD DOORS”

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Engineer, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys to Owner by registered mail or overnight package service.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Hinges: BHMA A156.1. Three plain-bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches, with removable pin.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: To be verified and coordinated with owner.
    1. Stair doors to have locking deadbolt with key only from stair side.
    2. All other interior doors shall have no locking functions.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

    1. Bored Locks: Minimum 1/2-inch latchbolt throw.

    2. Deadbolts: Minimum 1- inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

E. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

F. Roller Latches: BHMA A156.16; Grade 1; rolling plunger that engages socket or catch, with adjustable roller projection.

2.5 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

2.6 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2.7 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference to be verified and coordinated with owner.

1. Master key for all exterior and interior locks.

B. Keys: Nickel silver.

2.8 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

2.9 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions 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.

2.10 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.11 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:
1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.12 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.13 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Engineer.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

END OF SECTION 08 7100

SECTION 22 0400
COMMON REQUIREMENTS FOR PLUMBING

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the general requirements of these specifications and shall apply to all phases of the work indicated or required to provide for complete installation of all systems for this project.

B. This Section includes basic materials and methods to complement other Division 22 Sections.

1.02 WARRANTIES

A. Warrant all materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warrant period.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.03 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.04 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.05 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
   1. Architect: Architect or Engineer
   2. Code: All applicable national, state and local code

3. Mechanical: All plumbing and HVAC work required by the Contract Documents
4. Electrical: All electrical work required by the Contract Documents
5. Contractor: Any Contractor performing work required by the Contract Documents
6. Indicated: Shown on drawings, noted, scheduled or specified
7. Selected: Selected by the Architect or Engineer
8. Provide: Furnish, install, connect and tested complete and ready for use
9. Furnish: Supply and deliver to the site ready for installation
10. Install: Install complete, per Contract Documents and manufacturer's requirements.
11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and in parking garages.
14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
    a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.06 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols shown on the plans.

1.07 ABBREVIATIONS

A. Refer to abbreviations list shown on the Drawings.

1.08 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. All work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
   1. International Building Code (IBC)
   2. International Fire Code (IFC)
   3. International Energy Conservation Code (IECC)
   4. International Fuel Gas Code (IFGC)
   5. Uniform Plumbing Code(UPC)
   6. International Mechanical Code (IMC)
   7. Safety and Health Regulations for Construction
   8. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards

9. National Electrical Code (NEC)
10. National Fire Protection Association (NFPA)
11. Life Safety Code (NFPA 101)
12. American Gas Association (AGA)
13. Underwriters' Laboratories, Inc. (UL)
14. National Electrical Safety Code (NESC)
15. All applicable national, state and local codes and amendments.

1.09 PERMITS

A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them.

B. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.10 CODE COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that shown on the drawings shall not be substituted.

B. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

C. Where the National Electrical Code or applicable codes require controllers to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:
   1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
   2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
   3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
   4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufactures other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
      a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.
      b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
      c. The Contractor providing the substitution shall bear the total cost of all changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
   5. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.

6. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.

C. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

D. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:
1. Other section in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.
5. The shop drawing submittals shall be numbered consecutively under Specification Section 220400. The submittal subject shall clearly summarize the area or system being issued for review.
6. The product data submittal ID shall be numbered consecutively under the applicable Project Manual section, ending with the revision number. The submittal subject shall be the product data description.
   a. For example, the first revision of the second submittal for product data specified in Section 220523 shall have an ID of ‘220523-002-1’.
7. Submittals not listed in the Project manual shall reference the respective contract document.
8. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.
   a. Shop drawings and product data shall be in original searchable PDF format.
9. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for plumbing materials and equipment.
   a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
10. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
11. All submittals shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. All equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
12. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.
13. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.

14. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.

1.13 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, “Structural Welding Code-Steel”.

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications”.
   1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping”.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.14 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.15 COORDINATION

A. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

B. Provide offsets and elevation changes in piping as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

C. Arrange for spaces, chases, slots, and openings in building structure during progress of construction to allow for system installations.

D. Coordinate arrangement, mounting, and support of equipment.
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.

E. Coordinate routing of all piping in open and exposed areas with light fixture locations. Where piping will be installed at or below the mounting height of lights, piping shall not pass directly below or within a proximity that will create an obstruction to the required light pattern. Deviations and/or conflicts discovered in the field shall be resolved, to owner/architect/engineer satisfaction, at no additional cost to the project.

F. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

G. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

H. Coordinate service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing water, gas, electrical power and other services.

I. Coordinate location of access panels and doors for items that are concealed by finished surfaces.

J. Coordinate testing of items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.16 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted mechanical, electrical, plumbing system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Design Professionals for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

D. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

PART 2 PRODUCTS

2.01 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Specific Notes and/or Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.02 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.03 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.04 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.05 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.06 SEALANTS AND FIRESTOPPING

A. Manufacturers:
   1. Sealants:
      a. Dow Corning
      b. Pecora
      c. Sonneborn
      d. Tremco
   2. Firestopping Materials and Systems:
      a. A/D Fire Protection Systems Inc: www.adfire.com.
      b. 3M Fire Protection Products: www.3m.com/firestop.
      c. Hilti, Inc: www.us.hilti.com.
      d. Nelson FireStop Products: www.nelsonfirestop.com.
      e. Specified Technologies, Inc: www.stifirestop.com.
      f. Tremstop Fyre-Sil Sealant - Tremco Sealants & Coatings

B. Silicone Sealant: Single component, air curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type for application in vertical joints and in horizontal joints, color as selected.

C. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

D. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

E. Joint Backing: ANSI/ASTM D1056; round, closed cell, polyethylene foam rod; oversized 30% to 50% larger than joint width.

F. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

G. Firestopping Materials and Systems:
   1. UL Listed products and assemblies.
   2. Subject to compliance with the requirements of Division 07 Fire and Smoke Protection.

PART 3 EXECUTION

3.01 GENERAL

A. Fabrication, erection, and installation of the complete system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. The Contractor shall check all areas and surfaces where plumbing equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the plumbing work.

3.02 DELIVERY AND STORAGE OF MATERIALS

A. Take provisions for the delivery and safe storage of materials and shall make the required arrangements with other Contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. All items subject to cold weather damage shall be protected by covering, insulating, or storing in a heated space.

3.03 COOPERATION WITH OTHER CONTRACTORS

A. Perform the work in conformance with the construction called for by other trades and afford other Contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the work with the work of other Contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the plumbing work which might prevent prompt and proper installation of work required from other trades.

3.04 COORDINATION OF WORK

A. The list below is the precedence of assigned work items for space priority in descending order. Items not listed shall have the same precedence as similar items:
   1. In areas with finished ceilings: Reflected ceiling with all light fixtures, access above light fixtures required for maintenance, sprinkler head locations, and all ceiling fixtures and devices.
   2. Gravity flow plumbing waste, roof drainage, and other systems that rely upon gravity for flow.
   3. Ductwork and appurtenances, except that external bracing shall be relocated to accommodate local interference.
   4. In open and exposed areas: Exposed and surface mounted light fixtures and signs.
   5. Electrical conduit over 2 inches in diameter.
   6. HVAC piping except for pressurized domestic water piping.
   7. Plumbing vents.
   8. Electrical conduit under 2 inches in diameter.

B. Plan all work so it proceeds with a minimum of interference with other trades.

C. It shall also be the responsibility of the Contractor to inform the General Contractor of all openings required in the building construction for the installation of the plumbing work.

D. The Contractor shall cooperate with all other contractors in furnishing material and information, in proper sequence, for the correct location of all sleeves, inserts, foundations, wiring, etc.

E. Provisions shall be made for all special frames, openings, and sleeves as required.

F. The Contractor shall pay for extra cutting and patching made necessary by their failure to properly direct such work at the correct time.

3.05 LAYING OUT WORK

A. Carefully lay out all work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings, and shop drawings.

B. Equipment layout and all system layouts shall confirm adequate clearances for installation, operation, maintenance, and code-required clearances from the structure or other equipment and systems.

C. Provide offsets and elevation changes in piping as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

D. The layout shall not cause problems of operation, maintenance, or clearance for items installed by other Contractors.

E. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

F. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and shall request clarification.

G. Failure to properly coordinate and lay out the work will require correction by the Contractors at their own expense.

3.06 DATA AND MEASUREMENTS

A. Drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and shall adapt their work to actual conditions.

D. Examine the general construction, mechanical, electrical, and other applicable drawings and the Specifications.

E. Only architectural drawings, structural drawings, and site measurements may be utilized in calculations.

F. Layout and coordinate all work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

3.07 PROTECTION OF APPARATUS

A. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment, and installations from damage of any kind.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.08 EXAMINATION OF PREMISES

A. Examine the premises and all conditions thereon and/or therein. The bid proposal shall take into consideration all such conditions which may affect the work under this contract.

3.09 ROADWAYS, CURBS, AND WALKS

A. Use every possible precaution to prevent injuries to roadways, curbs, and walks on or adjacent to the site of the work.

B. Any damage shall be repaired at the Contractor's own expense. This shall also include damage necessary for installation of the plumbing work.

3.10 WORK IN EXISTING BUILDINGS

A. General: All work in the existing building, indicated on the drawings or specified herein, shall be executed with a minimum amount of interference with the normal activities of the occupants of the building.

B. All work shall be scheduled in advance with the Owner and shall not proceed without the Owner's written approval.

C. Utilities: Utilities shall not be interrupted without the Owner's prior written approval regarding the time and duration of such interruptions.
   1. Utilities to existing facilities shall not be disconnected until new or temporary facilities are installed except for short periods of interruption which are necessary for the performance of the new work and which are approved by the Owner.

D. Storm water may be temporarily diverted to surface drainage provided such drainage is arranged to prevent flooding of structures, basements, and excavations for construction.

E. Fire Alarm System: The existing fire alarm system shall remain functional throughout construction.
   1. As a minimum, the existing degree of protection shall be maintained for all areas.
   2. All required outages shall be coordinated with the Owner and the Fire Marshal.

F. Welding: The Owner shall be notified before starting welding or cutting.
   1. Fire extinguishers shall be immediately accessible when welding or cutting with an open flame or arc.

2. Welding or cutting with an open flame or arc shall be stopped not less than one hour before leaving the premises.

G. Noisy Operations: Noisy operations such as those involving use of air hammers, etc., in demolition, or cutting of openings shall be scheduled with the Owner.

H. Occupancy:
1. The Owner will continue to occupy the building and carry on normal activity. Each Contractor shall protect the occupied areas from dust, smoke, etc., by a method reviewed by the Architect.

I. Owner's Right to Direct Work: The Owner shall have the right to direct the places of beginning work, its prosecution, and the manner in which all work under this contract is to be conducted, insofar as may be necessary to secure the safe and proper progress and quality of the work.

J. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

K. Cutting and Patching:
1. Each Contractor shall be responsible for all cutting and patching required for the work.
2. Patching shall be done by persons skilled in the trade involved and shall be prepared to receive paint.
3. Openings through floors may be drilled up to 1 inch but shall be core drilled over 1 inch.
4. Whenever the building surfaces (walls, floors, etc.) and openings are modified, removed and/or replaced to accommodate the new work or to introduce into or remove items from the building, such surfaces or openings shall be carefully reinstalled in conformance with the applicable code to protect the integrity of the building.

L. Existing Piping or Plumbing Equipment:
1. If any existing piping or plumbing equipment is encountered which would interfere with the proper installation of new work, it shall be removed or relocated as required or as directed by the Architect.
2. Where existing work is to be modified, it shall be done in conformance with these specifications.
3. Materials used shall be the same as for new work unless otherwise specified.

3.11 DEMOLITION REQUIREMENTS

A. Information pertaining to the existing building has been obtained through the buildings original drawings where available. Report discrepancies to the architect/engineer prior to any demolition. Contractor shall field verify all existing conditions prior to commencing work.

B. The Owner shall have the first right of salvage for all items being removed or demolished. If owner declines, the contractor shall remove from the premises and dispose of properly. Verify owner's intent prior to removal or demolition.

C. Coordinate shut down of all utilities for demolition work with the owner.

D. Coordinate demolition with the work of other trades. Provide temporary utilities as required to allow the work of other trades to proceed.

E. Remove all plumbing fixtures and piping as indicated.

F. Remove all items and systems as indicated.

G. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
1. Piping to be removed: Remove portion of piping indicated to be removed and cap remaining piping with the same or compatible piping material.
2. Piping to be abandoned in place: Drain piping and cap with the same or compatible piping material.
3. Equipment to be removed: Disconnect and cap services and remove equipment.

4. Equipment to be removed and reinstalled: Disconnect and cap services and remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment fully operational.
5. Equipment to be removed and salvaged: Disconnect and cap services and remove equipment and deliver to owner.

H. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.12 SLEEVES AND FRAMES

A. All sleeves and frames shall be securely fastened to the walls. Provide for structural lintels in masonry wall openings.

3.13 FINISHED SURFACES PENETRATIONS

A. All piping penetrations of finished surfaces shall have escutcheons and/or closure plates.

B. Openings shall be cut only as large as required for the installation, sleeves, and/or frames installed flush with finished surfaces and grouted in place.

C. Surfaces around openings shall be left smooth and finished to match surrounding surface.

D. Pipe sleeves through floors in concealed locations and in unfinished spaces such as mechanical rooms, etc., shall extend 2 inches above finished floor level and shall be caulked watertight.

E. All other sleeves shall extend approximately 1/4 inch above finished floor but shall allow placement of escutcheons.

3.14 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

A. Subject to compliance with the requirements of Division 07 Fire and Smoke Protection.

B. Provide proper sizing when providing sleeves or core-drilled holes to accommodate their work through penetrating items.

C. All voids between sleeve or core-drilled hole and pipe passing through shall be firestopped to meet the requirements of ASTM E814.

D. Install all materials complete, attached securely and permanently in place in accordance with manufacturers' printed directions.

E. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

F. Do not cover installed firestopping until inspected by authority having jurisdiction.

G. Provide labeling required by code.

3.15 INSULATION

A. Continue pipe insulation through walls, floors, sleeves, hangers, and other penetrations.

B. Insulate pipe fittings, joints, valves, unions, flanges, strainers, flexible connections and expansion joints with insulation of like material and thickness as adjoining pipe.

C. Provide insulation jackets and/or covers as indicated.

3.16 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install as described below, unless individual Sections specify otherwise. Individual Sections specify unique installation requirements.

B. Refer to The Plumbing Fixture Schedule for all plumbing piping connection sizes to all plumbing fixtures.

C. Wall hydrants and downspout nozzles shall be installed between 18" and 24" above finished grade. Provide accessible shutoff valve located indoor for each wall hydrant.

D. Piping in exterior building walls shall be located on the warm side of building insulation and vapor barrier. Building insulation shall run continuous between piping and exterior of building.

E. PVC piping shall not be installed in return air plenums.

F. General Locations and Arrangements:
   1. Drawing plans, schematics, and diagrams indicate general, diagrammatic location and arrangement of systems.
   2. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
   3. Install systems as indicated, unless deviations to layout are approved on Coordination Drawings.
   4. Provide offsets and elevation changes in piping and conduit as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.
   5. Refer to architectural exterior and interior elevations for wall mounted device locations.
   6. Do not run piping above electrical or telecom panels or in code required clearance spaces.
   7. Do not run piping and plumbing above or through information technology and data closets, IDF, and MDF rooms or associated riser rooms. Coordinate all routing with other trades.
   8. Coordinate location of piping with electrical cable tray. Provide a minimum of 6" of clear access above cable tray for installation of cables.
   9. Install all horizontal piping in mechanical rooms at a minimum of 7'-6" above finished floor.
   10. Install exposed interior and exterior piping at right angles or parallel to building walls.
       a. Diagonal runs are prohibited, unless otherwise indicated.
   11. Conceal piping in walls, pipe chases, utility chases, above ceilings, below grade or floors, unless otherwise noted, except in mechanical rooms or service areas.
   12. Install piping to allow application of insulation plus 1-inch clearance around insulation.
   13. Pipe hangers for insulated pipe with vapor barrier jackets shall be installed around the outside of the insulation and a metal insulation support shield provided to prevent crushing of the insulation.
   14. Locate groups of pipes parallel to each other, spaced to permit insulation and valve servicing.
   15. Dielectric nipples or flange insulation kits shall be utilized for all dissimilar pipe connections. Dielectric unions will not be accepted.
   16. Install piping at indicated slope and as required by code.
   17. Provide components with pressure rating equal to or greater than system operating pressure.
   18. Install fittings for changes in direction and branch connections.
   19. Install piping free of sags or bends with ample space between piping to permit proper insulation applications.
   20. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building unless otherwise indicated.
       a. Allow sufficient space above ceiling panels to allow for ceiling panel removal.
   21. Install piping to allow for expansion and contraction without stressing pipe, adjacent building structure or connecting equipment.
       a. Provide expansion loops or compensators where indicated.
   22. Do not use ceiling support system to bear weight of devices or systems unless ceiling support system is certified as suitable to do so.
   23. During construction, avoid any undue loads, forces or strains on valves, equipment, pumps flanges, or building elements with piping connections or piping systems.
   24. Keep all pipe and equipment openings closed during construction except when actual work is being performed on that item or system.
   25. Leaking pipe joints shall be remade using new materials.
   26. Roof mounted piping and conduit:
       a. Coordinate all roof mounted support locations and loads with roofing contractor.

b. Space supports per all applicable codes and as indicated.
c. Provide 18" minimum under pipe and conduit to allow for roof repair.

27. Piping Penetrations:
    a. Provide pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
        1) Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
        2) Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
        3) Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
        4) Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
        5) Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

G. Kitchen Equipment Requirements:
1. All below floor sanitary piping shall be cast iron pipe unless indicated otherwise.
2. Provide shut-off valves for water supply at all equipment items.
3. Plumbing contractor to rough-in and make final connections to all utilities required and provide all piping, stops, vacuum breakers, water hammer arresters, pressure reducing valves, traps and all fittings necessary for equipment to be in operating order.
4. Coordinate with kitchen equipment contractor and see approvd kitchen equipment submittal and plans.
5. All exposed water piping to fixtures and kitchen equipment to be chrome plated.

H. Clean existing underground sanitary piping with cable and blade to first manhole prior to installation and connection of new piping.

I. Provide wall- and floor mounted sewer cleanouts as required by code. Coordinate location in field.

J. Locate plumbing vents through the roof at a minimum of 10'-0" away from all outdoor air intakes on HVAC equipment or operable windows.

K. Terminate all natural gas flue vents a minimum of 2'-0" higher than any surface or equipment within 10'-0" or as required by code.

L. Provide shut-off valves for water supply at all equipment items.

M. Coordinate finish floor elevations to set floor drains and floor sinks.

N. Saw cut and remove floor as required for installation of new piping.

O. Contractor is responsible for any cutting and patching needed for plumbing installation. Patching must match existing.

P. Verify final equipment locations for roughing-in of all systems.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.17 PIPING JOINT CONSTRUCTION

A. Drill and deburr all openings which are made after erection of the piping system.
1. Joints in steel pipe 2 inches and smaller shall be threaded in accordance with ANSI B1.1.
2. Ream threaded ends to remove burrs and restore full inside diameter.
3. Utilize pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint.
4. Tighten joints to leave not more than three threads exposed.

B. Pipe joints and steel pipe larger than 2 inches shall be welded in accordance with ASME Code for Pressure Piping B31.

C. Flanges on steel pipe larger than 2 inches shall be welded in accordance with ASME B31. Clean flange faces and install gaskets.
   1. Tighten bolts to torques specified by the manufacturer of the flange and flange bolts to provide uniform compression of gaskets.

D. Joints in non-ferrous pipe shall be brazed or soldered.
   1. Braze joints in accordance with ANSI B31.9 or B31.5.
   2. Thoroughly clean tube surface and inside surface of the fitting using emery cloth. Clean tube and fittings and apply flux.
   3. Flux shall not be used for cleaning tube and fitting surfaces.

E. Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
   1. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   2. Soldered Joints: Construct joints according to AWS's "Soldering Manual", Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook".
   3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
      b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
      c. Align threads at point of assembly.
      d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
      e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
   5. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
   6. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
   7. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
      a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
      b. ABS Piping: ASTM D 2235 and ASTM D 2661.
      c. CPVC Piping: ASTM D 2846 and ASTM F 493.
      d. PVC Pressure Piping: ASTM D 2672.
      e. PVC Nonpressure Piping: ASTM D 2855.
      f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
   8. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
      a. Plain-End Pipe and Fittings: Use butt fusion.
      b. Plain-End Pipe and Socket Fittings: Use socket fusion.

F. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

G. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.

H. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.18 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.19 INCIDENTAL WORK

A. The following incidental work shall be furnished by the designated contractor under the supervision of the Temperature Control Contractor:
   1. The Piping Contractor shall provide all necessary valved pressure taps, water, drain, and overflow connections and piping.
   2. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.
   3. The Electrical Contractor shall provide power wiring to the variable frequency controller.

3.20 LUBRICATION, TESTING AND TEST REPORTS

A. Upon completion of the work, the entire system shall be tested and proven for capacity of equipment, balance of system, proper operation of controls, and comfort of conditioned spaces.
   1. Prior to beginning systems testing, adjusting and balancing, replace all filter media with new media.
   2. Take air and water flow readings and submit copy of same to demonstrate proper flow according to the performances shown on the plans and noted in the specifications.
   3. Motors shall be checked for overload and belts adjusted.
      a. Align pulleys and install belts according to manufacturer's written instructions.
      b. Tension according to manufacturer's written instructions.
   4. Lubricate moving parts and clean or replace filters.
      a. Run in all bearings and, after they are run in, drain and flush bearings and refill with a new oil charge.
      b. Equipment shall be so arranged that tools (screwdrivers, wrenches, etc.) will not be required to make lubrication points accessible.
      c. Extensions on grease or oil fittings shall be provided where required for access to lubricate.
   5. Test piping systems per applicable codes and standards.
   6. Submit copies of all tests to the Architect for review prior to date of substantial completion.
   7. Equipment and systems discrepancies shall be corrected prior to final acceptance.

END OF SECTION

SECTION 22 0719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.

B. Glass fiber insulation.

1.02 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Products shall be certified by UL GREENGUARD GOLD or Indoor Advantage Gold.

F. Products shall certified to meet or exceed UL Standard 2818 -2013 Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings

G. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

2.02 GLASS FIBER INSULATION

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B. Insulation: ASTM C547and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
   1. K Value: ASTM C177, 0.23 at 75 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.
   1. Manufacturers:
      a. Childers Products CP-127.
      b. Foster Products 85-20/85-60.
      c. Eagle Bridges - Marathon Industries, Inc.
   2. Shall meet ASTM C916 Type I/II

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on Glass wool.

G. Fibrous Glass Fabric:
   1. Manufacturers:
      a. Fosters Mast a Fab.
      b. Childers Chil Glas #10.
   2. Cloth: Untreated; 9 oz/sq yd weight.
   3. Blanket: 1.0 pcf density.
   4. Weave: 5 by 5.

H. Indoor Vapor Barrier Finish:
   1. Manufacturers:
      a. Childers Products, Chil Out, CP-33.
      b. Foster Products Vapor Out. 30-33.
      c. Eagle Bridges - Marathon Industries, Inc.
   2. Cloth: Untreated; 9 oz/sq yd weight.
   3. Vinyl emulsion type acrylic, compatible with insulation, white color.
   4. Permeance shall be 0.07 perms or less at 45 mils dry tested by ASTM E96.

I. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC: www.armacell.us/#sle.
3. K-Flex USA LLC: www.kflexusa.com/#sle.
4. RBX Corp.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. K Value: ASTM C177; 0.25 at 75 degrees F.
2. Minimum Service Temperature: Minus 40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Moisture Vapor Permeability: .03 perm inch, when tested in accordance with ASTM E96/E96M.
5. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
1. Manufacturers:
a. Childers Products.
b. Foster Products.
c. Eagle Bridges - Marathon Industries, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Coat all elbows, fittings, valves and flanges with vapor barrier mastic and reinforcing mesh. Finish with PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.

I. Inserts and Shields:
1. Application: Insulated piping 3/4 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Shield shall span an arc of 180 degrees.

4. Match diameter of shield to OD of insulation.
5. Shield dimensions shall not be less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
6. Insert Location: Between support shield and piping and under the finish jacket.
7. Thermal-Hanger Insert Shields: Install according to manufacturer's written instructions.

J. Insulated Piping: Attach hangers and supports to piping as follows:
1. Piping Operating Above Ambient Temperature:
    a. Where piping is not supported on rollers or trapeze, hangers may project through insulation.
    b. For straight runs of piping, at points of support more than 100 feet from elbow or anchor point, use roller type supports.
    c. Where piping is supported on rollers or trapeze, support piping at outside diameter of insulation.
        1) NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
        2) NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.
2. Piping Operating Below Ambient Temperature: Support piping at outside diameter of insulation. Do not penetrate vapor barrier.
    a. NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
    b. NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.

K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

3.03 INSULATION AND JACKET SCHEDULE

A. Insulation thickness listed below is based on the thermal conductivity performance of the material listed.
1. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.
2. Alternative material thickness must be adjusted as required to provide equivalent conductivity performance.
3. Alternative material subtitution shall be reviewed by the Architect.

B. Indoor Piping:
1. Stormwater and Overflow:
    a. All Pipe Sizes:
        1) Glass-Fiber Pipe Insulation, Type I: 1/2 inch thick.
2. Plumbing Vents to 24 Inches Below Roof:
    a. All Pipe Sizes:
        1) Glass-Fiber Pipe Insulation, Type I: 1/2 inch thick.

END OF SECTION

SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Storm drainage piping, above grade.

B. Pipe flanges, unions, and couplings.

C. Joining materials.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CPVC: Chlorinated polyvinyl chloride plastic.

C. CR: Chlorosulfonated polyethylene synthetic rubber.

D. EPDM: Ethylene-propylene-diene terpolymer rubber.

E. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section1417.

F. NBR: Acrylonitrile-butadiene rubber.

G. PE: Polyethylene plastic.

H. PP: Polypropylene plastic.

I. PVC: Polyvinyl chloride plastic.

1.03 REFERENCE STANDARDS

A. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

B. ASME B31.2 - Fuel Gas Piping; The American Society of Mechanical Engineers; 1968.

C. ASME B31.9 - Building Services Piping.

D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

F. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for sanitary and storm drain, waste, and vent piping applications; 2009

G. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed.

H. ASTM B68M - Standard Specification for Seamless Copper Tube, Bright Annealed (Metric); 2011.

I. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.

J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

K. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.

L. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

M. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

N. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

O. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

P. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

Q. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

R. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.

S. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.

T. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

V. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

W. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

X. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

Y. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

Z. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

AA. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

BB. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

CC. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential.

DD. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

EE. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

FF. NSF/ANSI 14 - Plastics Piping System Components and Related Materials;

GG. NSF/ANSI 372 - Drinking Water System Components – Lead Content

1.04 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Project Record Documents: Record actual locations of valves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Valve Repacking Kits: One for each type and size of valve.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes and standards.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content =0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

D. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

E. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

F. Identify pipe with marking including manufacturer's registered trademark, country of origin, date of manufacture, size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

G. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.

H. Hubless Cast Iron pipe and fittings conform to ASTM A 888 or CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.

I. Hubless Couplings shall be listed by NSF® International and conform to ASTM C 1540 for super duty or heavy duty couplings where indicated. Gaskets shall conform to ASTM C 564.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for installation of backflow prevention devices.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Plenum-Installed Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.02 STORM DRAINAGE PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: ASTM C 1540 heavy duty stainless steel clamp-and-shield assemblies with ASTM C 564 neoprene gaskets.

2.03 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Sizes Over 1 inch:
   1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
   3. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
   4. Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
   1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
b. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

D. No-Hub (Hubless) Couplings:

E. Shielded, Heavy Duty No-Hub Couplings:
1. Testing: In accordance with ASTM C1540 and FM 1680.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

F. Dielectric Connections: Waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.
1. Dielectric unions shall not be used.
2. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
3. Insulating Material: Suitable for system fluid, pressure, and temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   a. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
5. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.
6. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.

2.04 JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Solvent Cements: Manufacturer's standard solvent cements for the following:
1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

E. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever joining dissimilar metals.
   1. Dielectric unions are not allowed.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 4 ft of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted.

N. Install water piping to ASME B31.9.

O. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

P. Install cast iron pipe in accordance with the “Cast Iron Soil Pipe Handbook” latest edition, as published by the Cast Iron Soil Pipe Institute.

Q. Any interior natural gas pressure regulators shall be vented to the exterior of the building per NFPA 54 / ANSI Z223.1.

R. Install plastic pipe below grade in accordance with ASTM D2321. This includes providing the specific trench width required for each pipe size, the specific embedment material required for backfill, and the required compaction for supporting the piping and resisting pipe deformation.

S. Sleeve pipes passing through partitions, walls, and floors.

T. Conceal all pipe in interior walls, piping chases, utility spaces, above ceilings or below grade or floors unless indicated to be exposed to view.
   1. Do not install domestic water piping in exterior walls.
   2. Piping chases located on exterior walls shall be ventilated, by openings, to interior spaces.

U. Piping shall be installed so as to allow for maintenance and removal of ceiling mounted equipment, heat pump, terminal units, etc..
   1. Verify and coordinate exact equipment locations and service requirements with Installing Contractor.

V. Provide cleanouts in sanitary and storm sysetms as required by code at each change of direction greater than 45 degrees at minimum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping at base of each vertical soil or waste stack 18 inches above finished floor elevation.

W. Provide drainage and vent piping runouts to plumbing fixtures and drains with trap of required size.

X. Vent terminals (VTRs) shall penetrate roof a minimum of 6 feet from any fire wall.

Y. PVC piping shall not be installed in return air plenums.

Z. Install expansion joints on vertical risers as indicated and required by codes.

AA. Install wall cleanout covers for concealed piping types as indicated and required by codes.

BB. Install flashing flange and clamping device at each stack or vent passing through waterproof membranes.

CC. Install vent flashing sleeves and stacks passing through roof. Secure over stack flashing in accordance with roofing manufacturer's requirements.

DD. Vent stacks shall terminate in accordance with applicable plumbing code or as follows:
1. At least 10 feet horizontally or 2 feet above doors, windows or other ventilating openings of the building or adjacent building.
2. No closer than 2 feet under any roof gable.
3. No closer than 2 feet from any wall extending above flat roof building.
4. No closer than 6 feet from any fire wall.
5. Minimum 7 feet above if roof is used for other purpose than weather protection (occupied).

EE. Provide sway bracing on no-hub piping as required by code.

FF. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated on the plans (if applicable) and slope to drain at minimum of 1/8 inch per foot slope.

3.05 FIELD QUALITY CONTROL

A. Test and balance all flow control, reducing, regulating, temperaturecontrol and relief valves for required flow and pressures per manufacturer's requirements. Submit documented and witnessed test and balance results for review.

B. Drainage Piping:
1. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
2. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
4. Test gravity drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

b. Leave new, altered, extended, or replaced pressurized drainage piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
c. Test Procedure: Test gravity drainage piping (except outside leaders) on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
d. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
e. Prepare reports for tests and required corrective action.

3.06 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

END OF SECTION

SECTION 23 0400
COMMON REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes basic materials and methods to complement other Division 23 Sections.

1.02 WARRANTIES

A. Warrant all materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warrant period.
   1. Repair or replacement of compressorized equipment shall include a complete refrigerant charge.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.03 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.04 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.05 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
   1. Architect: Architect or Engineer
   2. Code: All applicable national, state and local code
   3. Mechanical: All plumbing and HVAC work required by the Contract Documents
   4. Electrical: All electrical work required by the Contract Documents

5. Contractor: Any Contractor performing work required by the Contract Documents
6. Indicated: Shown on drawings, noted, scheduled or specified
7. Selected: Selected by the Architect or Engineer
8. Provide: Furnish, install, connect and tested complete and ready for use
9. Furnish: Supply and deliver to the site ready for installation
10. Install: Install complete, per Contract Documents and manufacturer's requirements.
11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
    a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.06 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols shown on the plans.

1.07 ABBREVIATIONS

A. Refer to abbreviations list shown on the Drawings.

1.08 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. All work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
1. International Building Code (IBC)
2. International Fire Code (IFC)
3. International Energy Conservation Code (IECC)
4. International Fuel Gas Code (IFGC)
5. Uniform Plumbing Code(UPC)
6. International Mechanical Code (IMC)
7. Safety and Health Regulations for Construction
8. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards
9. National Electrical Code (NEC)
10. National Fire Protection Association (NFPA)
11. Life Safety Code (NFPA 101)

12. American Gas Association (AGA)
13. Underwriters' Laboratories, Inc. (UL)
14. National Electrical Safety Code (NESC)
15. All applicable national, state and local codes and amendments.

1.09 PERMITS

A. The Contractors shall familiarize themselves with all requirements regarding all permits, fees, etc., and shall comply with them.

B. All permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

1.10 CODE COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that indicated shall not be substituted.

B. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

C. Where the National Electrical Code or applicable codes require controllers to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:
   1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
   2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
   3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
   4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufactures other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
      a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.
      b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
      c. The Contractor providing the substitution shall bear the total cost of all changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.
      d. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.
      e. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor

has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.

f. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

g. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:

1. Other section in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.
5. Submittals shall be labeled indicating the specification number and title, shop drawing or product data description and the respective Part 2 paragraph and sub-paragraph numbers.
6. Submittals not listed in the Project manual shall reference the respective contract document.
7. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.
   a. Shop drawings and product data shall be in original searchable PDF format.
8. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
   a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
9. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
10. All submittals shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. All equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
11. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect.
12. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.
13. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.
14. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.

B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building

components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work.

1. Include the following:
    a. Actual equipment being provided. Refer to manufacturer's data for physical size, access and maintenance requirements. Provide all code required clearances.
    b. Planned piping layout, including valve and specialty locations and valve-stem movement.
    c. Clearances for installing and maintaining insulation.
    d. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
    e. Equipment and accessory service connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Fire-rated wall and floor penetrations.
    h. Sizes and location of required concrete pads and bases.
    i. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
    j. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
    k. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, access doors or pabels and other ceiling-mounted items.
    l. All Contractors are required to provide information concerning their part of the work needed to develop the coordination drawings.
    m. Drawings shall contain all of the following that are applicable:
        1) Ductwork, equipment, and terminal devices (showing access and service requirements). Ductwork, equipment and terminal devices indicated in the coordination drawing content must be the same as that indicated in all submittals.
        2) Plumbing
        3) HVAC piping
        4) Recessed light fixtures
        5) Electrical conduit 2 inches and larger
        6) Fire sprinkler piping
        7) Structure and general construction
        8) Access doors and panels
        9) Other areas indicated by the Contractor that involve congestion
    n. Complete drawings after submitting product data on items included in coordination drawings.

C. Operation and Maintenance Manuals:
    1. Prepare electronic operation and maintenance manuals for the equipment furnished.
    2. The manual shall be in original searchable PDF format with equipment organized by specification section. Bookmarking shall be provided in the PDF for each specification section and piece of equipment.
    3. Manuals shall be submitted to the Architect for review and distribution to the Owner not less than 30 days prior to substantial completion of the project.
    4. Manuals not meeting the requirements of this section may be rejected by the Architect.
    5. Manual shall include, but shall not be limited to, the following:
        a. A cover page including:
            1) Project name and address
            2) Division of work covered by the manual
            3) Name, address and telephone number of Contractor and all Sub-Contractors including night or emergency numbers

b. A Complete Index. Contractor may submit the index to the Architect for review prior to submittal of complete manuals if desired.
c. Manufacturer's equipment product data O&M manuals and parts lists identified by the equipment mark used in the contract drawings.
d. Names, Addresses and Telephone Numbers. This list shall include the manufacturer and local representative who stocks or furnishes repair parts for all items of equipment and shall be typed on a single page in front of the manual.
e. Startup, Operation and Shutdown Procedures. Provide a written description of procedures for startup, operation and shutdown of each item or system. This description shall include motors to start, valves to open, etc., in proper sequence, and the location of switches, starters, pushbuttons and valves. Description shall include item references or labels used in the contract documents unless otherwise instructed in advance by the Owner.
f. Seasonal Changeover Procedure. Provide a written description of the procedure for necessary seasonable changeover from heating to cooling and vice versa.
g. Equipment Accessory Schedule. Upon completion of the work, furnish the Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required and the manufacturer of all renewable items.
h. Lubrication Schedule. Provide a chart listing each piece of equipment, the proper type of oil or grease required, and recommended frequency of lubrication.
i. Emergency Procedures. Provide a written description of emergency operating procedures or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency services to the various parts of the system.
j. One copy of all shop drawings.
k. Signed letters of certification of inspection and similar information.
l. All manufacturers' warranty information.
m. Provide documentation that training was performed for each item specified to include Owner training. Include name of Owner’s representative(s) present, date and time of training.
n. Normal Maintenance Schedule. Include a listing of work to be performed at various time intervals; i.e., 30, 90, 180 days and yearly.
o. Provide documentation that Extra Materials were received by the Owner for each section requiring Extra Materials.
p. Motor List. The list shall indicate motor location, equipment served (using labels indicated on drawings), horsepower, electrical characteristics, motor type, and rpm. Motors less than 1/2 horsepower need not be included.

1.13 OPERATING TRAINING

A. Complete operating instructions for each system and item of equipment shall be provided to the Owner's designated personnel.

B. Operation and Maintenance Manuals must be reviewed and accepted by the Architect and provided to the Owner prior to operating training.

C. Training shall be scheduled at the convenience of the Owner. A minimum of 4 hours, per system, of training shall be provided.

D. Training shall include instructions on the following:
1. Startup and shutdown procedures
2. Seasonal changeover
3. Periodic maintenance
4. Emergency operation
5. Safety

E. In addition to the instructions required above, wherever possible perform the operations being described in order to fully illustrate system operation.

F. At the completion of training, turn over to the Owner all required keys and special tools for installed equipment. Each key or tool shall be labeled with its use.

1.14 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, “Structural Welding Code-Steel”.

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications”.
   1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping”.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.16 COORDINATION

A. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of systems. Wherever practical, install systems as indicated.

B. Provide offsets and elevation changes in piping, conduit and ductwork as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

C. Arrange for spaces, chases, slots, and openings in building structure during progress of construction to allow for system installations.

D. Coordinate arrangement, mounting, and support of equipment.
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.

E. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

F. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

G. Coordinate service connections to components furnished by utility companies.
   1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for metering components.
   2. Comply with requirements of authorities having jurisdiction and of utility company providing water, gas, electrical power and other services.

H. Coordinate location of access panels and doors for items that are concealed by finished surfaces.

I. Coordinate testing of items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.17 OWNER EQUIPMENT NAMING CONVENTION

A. The owner utilizes a specific equipment naming convention that the contractor shall use for all nameplates and equipment references in all project documentation.

1.18 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted mechanical, electrical, plumbing system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Design Professionals for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, ductwork, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for designing, furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

D. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

PART 2 - PRODUCTS

2.01 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Specific Notes and/or Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.02 SHORT-CIRCUIT CURRENT RATING (SCCR) FOR EQUIPMENT AND ASSOCIATED CONTROL PANELS

A. SCCR Compliance - Equipment manufacturers and suppliers shall provide a certified SCCR for all equipment and associated panels to be provided with equipment procured under these specifications. The certified SCCR rating shall be no less than the value of the available fault current at the switchboard or panel serving the equipment as indicated on the Division 26 Electrical Riser Diagrams. Manufacturer shall provide internal components that meet or exceed the SCCR rating required by these specifications. Manufacturer shall refer to the National Electrical Code (NEC), which is also known as NFPA 70, Article 100 for additional requirements

B. Supplemental SCCR Compliance Data - At the manufactures option, they may calculate the available fault current at the specific equipment connection point. Manufacturer shall obtain feeder size, breaker type and length of feeder from the Division 26 contractor. All calculations shall be submitted as part of the equipment submittal for review by the engineer.

C. Application of Labels - All equipment and control panels associated with equipment procured under these specifications shall have a permanently installed label provided by the manufacturer as a part of the equipment indicating the SCCR rating of the equipment. Labels shall comply with NEC Article 409 - Industrial Control Panels, and NEC Article 670 - Industrial Machinery.

2.03 CONTROL SYSTEM INTERFACES

A. Equipment and systems shall be able to interface and integrate to BMCS systems and sequences via vendor protocols including, as a minimum, BACnet, LonTalk and Modbus.

2.04 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.05 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.06 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.07 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 PIPE OR CONDUIT PENETRATION HOUSING & HOODS

A. Manufacturer:
   1. RPH; www.RoofPenetrationHousings.com

B. References:
   1. ICC-500, FEMA 320/361 – Third Party Tested to +225 mph
   2. ICC 2015 Energy Code – Third Party Tested to ASTM E 2078-13 Standard Test Method for Air Permeance of Building Materials
   3. ASTM E 1980 Solar Reflectance Index (SRI)
   4. FEMA P749 – Seismic Provisions

C. Lid and housing lined with insulation to a minimum value of R-19.

D. Warranty: 20 years.

E. Roof Mounted: Engineered penetration housing, accommodating up to 18 pipes/conduits--cables, water, refrigeration, and power in one roof penetration with high rain tight integrity.

F. Roof penetration system is constructed of 14 gauge UV powder coated, welded, galvanized steel or aluminum with stainless steel hardware.
   1. Removable, gasketed lid to housing and housing to curb connection joints, pitched cover.
   2. Exit seal construction to be manufactured in all aluminum construction and 100% Sil-X-14 silicone gaskets.
   3. All seals must be protected from UV with an aluminum or stainless steel jacket.

G. Coordinate size of housing and hoods with all trades utilizing the penetration.

H. Furnish with 18-inch tall insulated curb and extensions for roof applications.

2.09 SEALANTS AND FIRESTOPPING

A. Manufacturers:
   1. Sealants:
      a. Dow Corning
      b. Pecora
      c. Sonneborn
      d. Tremco
   2. Firestopping Materials and Systems:
      a. A/D Fire Protection Systems Inc: www.adfire.com.
      b. 3M Fire Protection Products: www.3m.com/firestop.
      c. Hilti, Inc: www.us.hilti.com.
      d. Nelson FireStop Products: www.nelsonfirestop.com.
      e. Specified Technologies, Inc: www.stifirestop.com.
      f. Tremstop Fyre-Sil Sealant - Tremco Sealants & Coatings

B. Silicone Sealant: Single component, air curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type for application in vertical joints and in horizontal joints, color as selected.

C. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

D. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

E. Joint Backing: ANSI/ASTM D1056; round, closed cell, polyethylene foam rod; oversized 30% to 50% larger than joint width.

F. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

G. Firestopping Materials and Systems:
   1. UL Listed products and assemblies.
   2. Subject to compliance with the requirements of Division 07.

2.10 ACCESS DOORS

A. Manufacturers:
   1. Access Doors:
      a. J. L. Industries
      b. Karp Associates, Inc.
      c. Larsons Mfg. Co.
      d. Milcor, Inc.
      e. Miller Limited Partnership
      f. Nystrom, Inc.

B. Prime coated 14 gauge steel, flush, with screwdriver operated cam lock, frame to accommodate construction type; size as indicated.

2.11 ELECTRICAL WIRE

A. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. All wiring running exposed in return air plenums shall be plenum-rated cable for fire and smoke spread.

2.12 LOW VOLTAGE CONTROL WIRE AND CABLE

A. All wiring materials section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable.

B. Analog Input, Analog Output, Binary Input, Binary Output, 24 VAC, and General Purpose Cabling:

1. Cable shall consist of copper conductors not less than #18 AWG stranded.
2. Cable shall be two- or three-conductor twisted cable with a drain wire.
3. Cable shall have a 100 percent overall shield.
4. Cable shall be plenum rated.
5. Cable shall meet or exceed NEC voltage rating of 300 volts.
6. Cable shall be NEC type CMP.
7. Cable shall meet or exceed UL temperature rating of +60 deg C.

C. Primary and Secondary Communications Network Cabling:
1. Cable shall be of type recommended by the DDC system manufacturer.
2. Cable shall be shielded.
3. Cable shall be plenum rated.
4. Cable shall meet or exceed NEC voltage rating of 150 volts.
5. Cable shall meet or exceed UL temperature rating of +60 deg C.

PART 3 - EXECUTION

3.01 GENERAL

A. Fabrication, erection, and installation of the complete mechanical system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. The Contractor shall check all areas and surfaces where mechanical equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the mechanical work.

D. Equipment and systems shall be installed in accordance with manufacturer's instructions, requirements, or recommendations.

3.02 DELIVERY AND STORAGE OF MATERIALS

A. Take provisions for the delivery and safe storage of materials and shall make the required arrangements with other Contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. Contractor shall be responsible for adequately protecting all supplies and equipment during cold weather.

D. All items subject to cold weather damage shall be protected by covering, insulating, or storing in a heated space.

3.03 COOPERATION WITH OTHER CONTRACTORS

A. Perform the work in conformance with the construction called for by other trades and afford other Contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the mechanical work with the work of other Contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the mechanical work which might prevent prompt and proper installation of work required from other trades.

E. Systems Test and Balance Contractors or personnel shall coordinate their work with the contractors who installed the systems being tested or balanced.

F. The Temperature Control Contractor or personnel shall be present during systems test and balance.

3.04 COORDINATION OF WORK

A. The list below is the precedence of assigned work items for space priority in descending order. Items not listed shall have the same precedence as similar items.
   1. Reflected ceiling with all light fixtures, access above light fixtures required for maintenance, sprinkler head locations, and all ceiling fixtures and devices.
   2. Space designed for future utility placement.
   3. Gravity flow plumbing waste, roof drainage, and other systems that rely upon gravity for flow.
   4. Ductwork and appurtenances, except that external bracing shall be relocated to accommodate local interference.
   5. Fire sprinkler piping.
   6. Electrical conduit over 2 inches in diameter.
   7. HVAC piping except for pressurized domestic water piping.
   8. Plumbing vents.
   9. Electrical conduit under 2 inches in diameter.

B. Plan all work so it proceeds with a minimum of interference with other trades.

C. It shall also be the responsibility of the Mechanical Contractor to inform the Contractor of all openings required in the building construction for the installation of the mechanical work.

D. The Contractor shall cooperate with all other contractors in furnishing material and information, in proper sequence, for the correct location of all sleeves, inserts, foundations, wiring, etc.

E. Provisions shall be made for all special frames, openings, and sleeves as required.

F. The Contractor shall pay for extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

3.05 ELECTRICAL WIRING

A. Install wiring in accordance with National Electric Code, ANSI/NFPA 70.

B. All wiring materials covered by this section shall be in accordance with the latest revision of the National Electrical Code and applicable local codes and shall carry the UL label where applicable. All wiring running exposed in air plenums shall be plenum cable.

C. Install wiring (low and line voltage) in metal raceways or conduit unless inside control cabinet or unit enclosures.
   1. For concealed and accessible areas, plenum-rated wiring and cabling may be used.

D. Low voltage wiring not installed in conduit shall be supported every five feet from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

E. Low voltage control wiring and 24 VAC can be run in the same conduit. Power wiring 120 VAC and greater must be in a separate conduit.

F. Fastening shall be secured to walls or ceilings by means of appropriate screws, expansion screws anchors, toggle bolts, hollow wall screw anchors, nylon expansion anchors, or expansion shields. All-purpose plastic anchors are not acceptable.

G. Locate circuits, relays, transformers, or other equipment that contains or must be connected to voltages exceeding 130 volts, in separate cabinets, which may be adjacent to control panels; permanently label "DANGER 277 VOLTS" or appropriate volts.

H. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size shall be 3/4 inch.

3.06 CONTROL WIRING AND POWER CONNECTIONS

A. Provide all incidental control power and wiring required to make the equipment or systems fully operational. Coordinate with equipment manufacture incidental wiring requirements.

B. Unless indicted elsewhere, provide line voltage, 120VAC, 20 amp dedicated control power circuits and LAN outlet to each of the following and as indicated:
   1. BMCS Control panel, 1 circuit.
   2. Rooftop Unit, 1 circuit.
   3. Air Terminal Unit Power supply transformer panel, 1 circuit per 20 terminal units.
   4. DDC Power supply and transformer panel. 1 circuit can power 30 terminal units.
   5. Coordinate required 120V power circuits and LAN outlets with Electrical Contractor.

C. Incidental control wiring includes but not limited to:
   1. Air Handling Units:
      a. Fans
      b. Damper Operators
      c. DX Cooling
      d. Gas Heating
      e. Valve Operators
   2. Energy Recovery, Make-up Units and Ventilators
   3. Equipment Motors Starters
   4. HVAC Controls (Including but not limited to):
      a. Manufacturer's Packaged Control Systems
      b. Control Relays
      c. Air Terminal Units
      d. Control Dampers and Valves
      e. Transmitters
   5. Loose Motor Starters
   6. Manual Multi-Speed Switches (Furnished as an Accessory to Mechanical Equipment)
   7. Packaged Rooftop Units, Packaged Exhaust Fan and Make-Up Air Systems
      a. Provide 3/4 inch conduit with a minimum of eight distinctively colored or tagged #14 wires between units and remote panels or thermostats for control wiring
   8. Pushbutton Stations and Emergency Stop Switches
   9. Pumps
   10. Remote Monitoring and Control Panels (Provided by Equipment Manufacturers)
   11. Smoke Dampers at Air Handling Units
   12. Supply, Return and Exhaust Fans
   13. Temporary Heating/Cooling Equipment
   14. Unit Mounted Motor Starters, Contactors, Disconnect Switches, Thermal Overloads and Heaters
   15. Variable Frequency Controls.

3.07 LAYING OUT WORK

A. Carefully lay out all work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings, and shop drawings.

B. Equipment layout and all system layouts shall confirm adequate clearances for installation, operation, maintenance, and code-required clearances from the structure or other equipment and systems.

C. Provide offsets and elevation changes in piping, conduit and ductwork as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.

D. The layout shall not cause problems of operation, maintenance, or clearance for items installed by other Contractors.

E. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

F. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and shall request clarification.

G. Failure to properly coordinate and lay out the work will require correction by the Contractors at their own expense.

3.08 DATA AND MEASUREMENTS

A. Mechanical and electrical drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and shall adapt their work to actual conditions.

D. Examine the general construction, mechanical, electrical, and other applicable drawings and the Specifications.

E. Only architectural drawings, structural drawings, and site measurements may be utilized in calculations.

F. Layout and coordinate all work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

3.09 POSITION OF DEVICES

A. Locate devices mounted on finished surfaces with regard to paneling, furring, trim, etc. Where several devices occur in a room, they shall be symmetrically arranged as reviewed by the Architect.

B. Devices improperly located or installed shall be repaired, replaced or relocated at the Contractor's expense.

C. Devices shall be set plumb or horizontal and shall extend to the finished surface of the wall, ceiling, or floor without projecting beyond the surface.

D. Devices shown on wood trim, cases, or other fixtures shall be installed symmetrically and, where necessary, shall be set with the long dimension of the plate horizontal.

E. Coordinate their respective devices so as not to destroy the aesthetic effect of the surface in which the devices are mounted.

F. Coordinate the locations of all mechanical items with work furnished by other trades to avoid interference.

G. If the required coordination is not done, the outlets or devices shall be removed and relocated if so directed by the Architect and the damaged surfaces repaired at the Contractor's expense.

H. Devices shall be installed at the height shown below unless otherwise noted. All heights of devices are measured from finished floor to centerline of device.

I. Heights may be adjusted to correspond to nearest masonry course or as necessary to clear wall-mounted cabinets, fin tube convectors, unit heaters, etc.
   1. Temperature control panels: 60 inches
   2. Thermostats: 48 inches
   3. Carbon dioxide (CO2) sensors: 48 inches

3.10 PROTECTION OF APPARATUS

A. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment, and installations from damage of any kind.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.11 ACCESS TO EQUIPMENT

A. All motors, terminal boxes, valves, control devices, specialties, etc., shall be located to provide for easy access for operation, repair and maintenance; if concealed, access doors shall be provided.

B. Access doors required for access to equipment requiring inspection or service shall be provided.

C. Provide all access doors not already furnished by other Contractors but which are required for access to mechanical equipment.

D. Doors shall be 12 inches by 12 inches unless shown otherwise.

E. Person access doors shall be 18 inches by 18 inches minimum.

3.12 ROADWAYS, CURBS, AND WALKS

A. Use every possible precaution to prevent injuries to roadways, curbs, and walks on or adjacent to the site of the work.

B. Any damage shall be repaired at the Contractor's own expense. This shall also include damage necessary for installation of the mechanical work.

3.13 WORK IN EXISTING BUILDINGS

A. General: All work in the existing building, indicated on the drawings or specified herein, shall be executed with a minimum amount of interference with the normal activities of the occupants of the building.

B. All work shall be scheduled in advance with the Owner and shall not proceed without the Owner's written approval.

C. Utilities: Utilities shall not be interrupted without the Owner's prior written approval regarding the time and duration of such interruptions.
   1. Utilities to existing facilities shall not be disconnected until new or temporary facilities are installed except for short periods of interruption which are necessary for the performance of the new work and which are approved by the Owner.

D. Storm water may be temporarily diverted to surface drainage provided such drainage is arranged to prevent flooding of structures, basements, and excavations for construction.

E. Fire Alarm System: The existing fire alarm system shall remain functional throughout construction.
   1. As a minimum, the existing degree of protection shall be maintained for all areas.
   2. All required outages shall be coordinated with the Owner and the Fire Marshal.

F. Welding: The Owner shall be notified before starting welding or cutting.
   1. Fire extinguishers shall be immediately accessible when welding or cutting with an open flame or arc.
   2. Welding or cutting with an open flame or arc shall be stopped not less than one hour before leaving the premises.

G. Noisy Operations: Noisy operations such as those involving use of air hammers, etc., in demolition, or cutting of openings shall be scheduled with the Owner.

H. Occupancy:
   1. The Owner will continue to occupy the building and carry on normal activity. Each Contractor shall protect the occupied areas from dust, smoke, etc., by a method reviewed by the Architect.

I. Owner's Right to Direct Work: The Owner shall have the right to direct the places of beginning work, its prosecution, and the manner in which all work under this contract is to be conducted, insofar as may be necessary to secure the safe and proper progress and quality of the work.

J. Coordinate locations of new fire suppression, plumbing and HVAC penetrations through existing structure and construction. Utilize all existing documentation of conditions for coordination. Verify penetrations utilizing GPR (Ground Penetrating Radar) as necessary to confirm penetration locations.

K. Cutting and Patching:
   1. Each Contractor shall be responsible for all cutting and patching required for the work.

2. Patching shall be done by persons skilled in the trade involved and shall be prepared to receive paint.
3. Openings through floors may be drilled up to 1 inch but shall be core drilled over 1 inch.
4. Whenever the building surfaces (walls, floors, etc.) and openings are modified, removed and/or replaced to accommodate the new work or to introduce into or remove items from the building, such surfaces or openings shall be carefully reinstalled in conformance with the applicable code to protect the integrity of the building.

L. Existing Piping, Ductwork, or Mechanical Equipment:
1. If any existing piping, ductwork or mechanical equipment is encountered which would interfere with the proper installation of new work, it shall be removed or relocated as required or as directed by the Architect.
2. Where existing work is to be modified, it shall be done in conformance with these specifications.
3. Materials used shall be the same as for new work unless otherwise specified.

3.14 DEMOLITION

A. Information pertaining to the existing building has been obtained through the buildings original drawings where available. Report discrepancies to the architect/engineer prior to any demolition. Contractor shall field verify all existing conditions prior to commencing work.

B. The Owner shall have the first right of salvage for all items being removed or demolished. If owner declines, the contractor shall remove from the premises and dispose of properly. Verify owner's intent prior to removal or demolition.

C. Coordinate shut down of all utilities for demolition work with the owner.

D. Coordinate demolition with the work of other trades. Provide temporary utilities as required to allow the work of other trades to proceed.

E. Remove all items and systems as indicated.

F. Disconnect, demolish, and remove systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

G. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.15 FRAMES

A. Ducts passing through masonry walls shall be installed in steel angle iron frames and sleeves.

B. All sleeves and frames shall be securely fastened to the walls. Provide for structural lintels in masonry wall openings.

C. Ducts passing through openings in poured concrete walls and floors need not have frames.

3.16 FINISHED SURFACES PENETRATIONS

A. All piping and ductwork penetrations of finished surfaces shall have escutcheons and/or closure plates.

B. Openings shall be cut only as large as required for the installation, sleeves, and/or frames installed flush with finished surfaces and grouted in place.

C. Surfaces around openings shall be left smooth and finished to match surrounding surface.

D. Duct frames and pipe sleeves through floors in concealed locations and in unfinished spaces such as mechanical rooms, etc., shall extend 2 inches above finished floor level and shall be caulked watertight.

E. All other sleeves shall extend approximately 1/4 inch above finished floor but shall allow placement of escutcheons.

3.17 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

A. Subject to compliance with the requirements of Division 07.

B. Provide proper sizing when providing sleeves or core-drilled holes to accommodate their work through penetrating items.

C. All voids between sleeve or core-drilled hole and pipe passing through shall be firestopped to meet the requirements of ASTM E814.

D. Install all materials complete, attached securely and permanently in place in accordance with manufacturers' printed directions.

E. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

F. Do not cover installed firestopping until inspected by authority having jurisdiction.

G. Install labeling required by code.

3.18 PIPING AND/OR DUCTWORK SYSTEMS - COMMON REQUIREMENTS

A. General: Install as described below, unless individual Sections specify otherwise. Individual Sections specify unique installation requirements.

B. General Locations and Arrangements:
   1. Drawing plans, schematics, and diagrams indicate general, diagrammatic location and arrangement of systems.
   2. Indicated locations and arrangements were used to size pipe or ductwork and calculate friction loss, expansion, pump and fan sizing, and other design considerations.
   3. Install systems as indicated, unless deviations to layout are approved on Coordination Drawings.
   4. Provide offsets and elevation changes in ductwork, piping and conduit as required to complete the Layout and Coordination Process. Offsets and elevation change information shall be indicated in the coordination process documentation and must be submitted for review.
   5. Refer to architectural reflected ceiling plans for exact diffuser, register, grille, and ceiling mounted device locations.
   6. Do not run ductwork and piping above electrical panels or in code required clearance spaces.
   7. Do not run ductwork, piping, and plumbing above or through information technology and data closets, IDF, and MDF rooms. Coordinate all routing with other trades.
   8. Coordinate location of ductwork and piping with electrical cable tray. Provide a minimum of 6" of clear access above cable tray for installation of cables.
   9. Install all horizontal ductwork and piping in mechanical rooms at a minimum of 7'-6" above finished floor.
   10. Install exposed interior and exterior piping and ductwork at right angles or parallel to building walls.

a. Diagonal runs are prohibited, unless otherwise indicated.

11. Conceal ductwork and piping in walls, pipe chases, utility chases, above ceilings, below grade or floors, unless otherwise noted, except in mechanical rooms or service areas.
12. Install piping and ductwork to allow application of insulation plus 1-inch clearance around insulation.
13. Pipe hangers for insulated pipe with vapor barrier jackets shall be installed around the outside of the insulation and a metal insulation support shield provided to prevent crushing of the insulation.
14. Locate groups of pipes parallel to each other, spaced to permit insulation and valve servicing.
15. Dielectric nipples or flange insulation kits shall be utilized for all dissimilar pipe connections. Dielectric unions will not be accepted.
16. Install piping at indicated slope and as required by code.
17. Provide components with pressure rating equal to or greater than system operating pressure.
18. Install fittings for changes in direction and branch connections.
19. Install piping free of sags or bends with ample space between piping to permit proper insulation applications.
20. Install ductwork and piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building unless otherwise indicated.
    a. Allow sufficient space above ceiling panels to allow for ceiling panel removal.
21. Install ductwork and piping to allow for expansion and contraction without stressing pipe, adjacent building structure or connecting equipment.
    a. Provide expansion loops or compensators where indicated.
22. Do not use ceiling support system to bear weight of devices or systems unless ceiling support system is certified as suitable to do so.
23. During construction, avoid any undue loads, forces or strains on valves, equipment, pumps flanges, or building elements with piping connections or piping systems.
24. Keep all pipe, duct, and equipment openings closed during construction except when actual work is being performed on that item or system.
25. Leaking pipe and duct joints shall be remade using new materials.
26. Roof mounted piping, conduit and ductwork:
    a. Coordinate all roof mounted support locations and loads with roofing contractor.
    b. Space supports per all applicable codes and as indicated.
    c. Provide 18" minimum under pipe, duct and conduit, to allow for roof repair.
27. Piping Penetrations:
    a. Provide pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
        1) Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
        2) Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
        3) Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
        4) Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
        5) Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

C. All insulation shall meet the applicable energy code's installed R value requirements.

D. Contractor is responsible for any cutting and patching needed for mechanical installation. Patching must match existing.

E. Size and route refrigerant piping per manufacturers' recommendations.

F. Verify final equipment locations for roughing-in of all systems.

G. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.19 PIPING JOINT CONSTRUCTION

A. Piping branch takeoffs shall be fabricated using standard manufactured welding or threaded tees.
   1. Branch welds reinforced with welding saddles or by forged steel reinforcement fittings such as weldolets, threadolets and sockolets will be allowed on 2 inch and smaller branch connections.
   2. On 3 inch and larger pipes, main lines two or more pipe sizes larger than the branch must be for forged steel reinforcement fitting connections.

B. Drill and deburr all openings which are made after erection of the piping system.
   1. Joints in steel pipe 2 inches and smaller shall be threaded in accordance with ANSI B1.1.
   2. Ream threaded ends to remove burrs and restore full inside diameter.
   3. Utilize pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint.
   4. Tighten joints to leave not more than three threads exposed.

C. Pipe joints and steel pipe larger than 2 inches shall be welded in accordance with ASME Code for Pressure Piping B31.

D. Flanges on steel pipe larger than 2 inches shall be welded in accordance with ASME B31. Clean flange faces and install gaskets.
   1. Tighten bolts to torques specified by the manufacturer of the flange and flange bolts to provide uniform compression of gaskets.

E. Joints in non-ferrous pipe shall be brazed or soldered.
   1. Braze joints in accordance with ANSI B31.9 or B31.5.
   2. Thoroughly clean tube surface and inside surface of the fitting using emery cloth. Clean tube and fittings and apply flux.
   3. Flux shall not be used for cleaning tube and fitting surfaces.

F. Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
   1. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   2. Soldered Joints: Construct joints according to AWS's "Soldering Manual", Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook".
   3. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
      b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
      c. Align threads at point of assembly.
      d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
      e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
   5. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
   6. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

7. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. ABS Piping: ASTM D 2235 and ASTM D 2661.
   c. CPVC Piping: ASTM D 2846 and ASTM F 493.
   d. PVC Pressure Piping: ASTM D 2672.
   e. PVC Nonpressure Piping: ASTM D 2855.
   f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
8. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
   a. Plain-End Pipe and Fittings: Use butt fusion.
   b. Plain-End Pipe and Socket Fittings: Use socket fusion.

G. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

H. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.

I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.20 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Provide unions, in piping 2-inch NPS and smaller, adjacent to each control valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
   2. Provide flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
   3. Dry Piping Systems: Provide dielectric flanges and nipples to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Provide dielectric flanges and nipple fittings to connect piping materials of dissimilar metals.

3.21 TERMINAL EQUIPMENT CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in hydronic, steam and condensate, and refrigerant piping systems.

B. Size for supply and return piping connections shall be same as for coil and equipment connections.

C. Install control valves and accessories in accessible locations close to connected equipment.

D. When control valve sizes are smaller than indicated pipe or equipment connection size, provide eccentric reducers on inlet and outlet of control valve.

E. When coil banks are comprised of multiple coils, size individual coil supply and return piping connections same as manufacturer's provided coil connections.

F. Install piping adjacent to coils to allow service and maintenance.

G. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping.

H. Connect steam piping with gate valve and union and steam condensate piping with union, strainer, trap, and gate valve to allow coils to be disconnected without draining piping.

I. Provide bypass piping with globe valve around control valve as indicated. If multiple, parallel control valves are installed, only one bypass is required.

J. Provide ports for pressure and temperature gages at coil inlet connections.

K. Connect condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Provide cleanouts in piping at changes of direction.

3.22 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to manufacturer's requirements and submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components.

E. Connect equipment for ease of disconnecting, with minimum interference to other installations.

F. Install equipment giving right of way to piping installed at required slope.

G. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.23 CONCRETE BASES AND HOUSEKEEPNG PADS

A. Anchor equipment to concrete base or pads according to equipment manufacturer's written instructions and according to applicable seismic codes.
   1. Provide bases and pads of dimensions and locations indicated, but not less than 6 inches larger in both directions than supported unit.
   2. Use 3000-psi, 28-day compressive-strength concrete.
   3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   6. Install anchor bolts to elevations required for proper attachment to supported equipment.
   7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   8. Bases and pads poured on reinforced concrete slabs shall be a minimu of 4" thick, have 6 x 6 x 10/10 welded wire fabric and shall be doweled to the slab.
   9. Self-supporting isolating bases and pads shall be a minimum of 12" thick, have #4 reinforcing bars at 8 inches center to center each way and shall have an expansion joint around the perimeter of the adjoining slab.

3.24 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.25 INCIDENTAL WORK

A. The following incidental work shall be furnished by the designated contractor under the supervision of the Temperature Control Contractor:
   1. The Piping Contractor shall install automatic valves and separable wells that are specified to be furnished by the Temperature Control Contractor.
   2. The Piping Contractor shall provide all necessary valved pressure taps, water, drain, and overflow connections and piping.

3. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.
4. The Air Distribution Contractor shall install all automatic dampers furnished by the Temperature Control Contractor.
5. The Air Distribution Contractor shall provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
6. The Electrical Contractor shall provide power wiring to the variable frequency drives.
7. The Air Distribution Contractor shall assemble multiple section automatic dampers, furnished by the Temperature Control Contractor, with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper actuators.
8. The Air Distribution Contractor shall provide necessary sheet metal baffle plates to eliminate stratification while providing air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification has been eliminated.
9. The Air Distribution Contractor shall provide access doors or other approved means of access through ducts for service to control equipment.
10. Supply and return air motorized smoke dampers shall be provided by the Air Distribution Contractor on all air handling units 15,000 cfm and larger, as required by NFPA 90A, and shall be controlled by the Temperature Control Contractor. Dampers shall close when fan stops and open when fan starts.

3.26 LUBRICATION, TESTING AND TEST REPORTS

A. Upon completion of the work, the entire system shall be tested and proven for capacity of equipment, balance of system, proper operation of controls, and comfort of conditioned spaces.
   1. Prior to beginning systems testing, adjusting and balancing, replace all filter media with new media.
   2. Test and balance procedures and documentation shall be in accordance with AABC, NEBB, or SMACNA unless indicated otherwise.
   3. Take air and water flow readings and submit copy of same to demonstrate proper flow according to the performances shown on the plans and noted in the specifications.
   4. Motors shall be checked for overload and belts adjusted.
      a. Align pulleys and install belts according to manufacturer's written instructions.
      b. Tension according to manufacturer's written instructions.
   5. Lubricate moving parts and clean or replace filters.
      a. Run in all bearings and, after they are run in, drain and flush bearings and refill with a new oil charge.
      b. Equipment shall be so arranged that tools (screwdrivers, wrenches, etc.) will not be required to make lubrication points accessible.
      c. Extensions on grease or oil fittings shall be provided where required for access to lubricate.
   6. Smoke evacuation systems shall be tested in accordance with the requirements of the authority having jurisdiction and applicable codes and standards.
   7. Test piping systems per applicable codes and standards.
   8. Test ductwork systems per SMACNA and applicable codes and standards.
   9. Submit all test reports to the Architect for review prior to date of substantial completion.
   10. Equipment and systems discrepancies shall be corrected prior to final acceptance.

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

B. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

E. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

F. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

G. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.

H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

I. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

J. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Products shall be certified by UL GREENGUARD GOLD or Indoor Advantage Gold.

F. Products shall certified to meet or exceed UL Standard 2818 -2013 Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings

G. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

H. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
   1. Aeroflex USA, Inc: www.aeroflexusa.com.
   2. Armacell International; Armaflex: www.armacell.com.
   3. K-Flex USA LLC: www.kflexusa.com.
   4. RBX Corp.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. K Value: 0.25 at 75 degrees F.
   2. Minimum Service Temperature: Minus 40 degrees F.
   3. Maximum Service Temperature: 220 degrees F.
   4. Moisture Vapor Permeability: .03 perm inch.
   5. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.03 JACKETS AND COVERS

A. PVC Plastic:
   1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil, 0.010 inch.
      e. Connections: Brush on welding adhesive.
   2. Covering Adhesive Mastic: Compatible with insulation.
      a. Manufacturers:
         1) Childers Products Vi Cryl CP-10/11.
         2) Foster Products Weatherite 46-50.
         3) Eagle Bridges - Marathon Industries, Inc.

B. Self-Adhering Jacketing:
   1. Manufacturers:
      a. Venture Tape

b. Fosters
c. Polyguard

2. Jacket: Multi-ply, laminated, flexible, self-adhering, protective jacketing, vapor barrier, and weatherproofing membrane.
   a. Maximum Service Temperature: 250 degrees F.
   b. Minimum Service Temperature: -40 degrees F.
   c. Moisture Vapor Permeability: 0000 per inch, when tested in accordance with ASTM E-96.
   d. Mold inhibitors incorporated.
   e. UV stable.
   f. Minimum Thickness: 5.0 mils.

2.04 ACCESSORIES

A. General Requirements:
   1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
   2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
   3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
   4. Supply materials that are asbestos free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
   1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.

I. Inserts and Shields:
   1. Application: Insulated piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Shield shall span an arc of 180 degrees.
   4. Match diameter of shield to OD of insulation.
   5. Shield dimensions shall not be less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

6. Insert location: Between support shield and piping and under the finish jacket.
7. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
8. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
9. Steel Pipe Saddles:
   a. Provide on all steam and steam condensate piping 3" and larger.
   b. Provide on all heating hot water piping, operating above 200 degrees F, 3" and larger.
10. Thermal-Hanger Shield Inserts: Install according to manufacturer's written instructions.

J. Insulated Piping: Attach hangers and supports to piping as follows:
1. Piping Operating Above Ambient Temperature:
   a. Where piping is not supported on rollers or trapeze, hangers may project through insulation.
   b. For straight runs of piping, at points of support more than 100 feet from elbow or anchor point, use roller type supports.
   c. Where piping is supported on rollers or trapeze, support piping at outside diameter of insulation.
      1) NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
      2) NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.
2. Piping Operating Below Ambient Temperature: Support piping at outside diameter of insulation. Do not penetrate vapor barrier.
   a. NPS Smaller than 2: Provide MSS SP-58, Type 40, protective shield.
   b. NPS 2 1/2 and Larger: Provide thermal-hanger shield insert and weight-distribution plate.

K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

3.03 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.04 INSULATION AND JACKET SCHEDULE

A. Insulation thickness listed below is based on the thermal conductivity performance of the material listed.
1. Alternative material thickness must be adjusted as required to provide equivalent conductivity performance.
2. Alternative material subtitution shall be reviewed by the Architect.

B. Provide insulation thickness based on 2018 International Energy Conservation Code minimum requirements.

C. Indoor Piping:
1. Refrigerant Piping and Tubing:
a. Low Pressure Suction/Vapor (40-90 degrees F), all pipe sizes:
1) Flexible Elastomeric: 1 inch thick.

b. High Pressure Suction/Vapor (91-220 degrees F), all pipe sizes:
1) Flexible Elastomeric: 2 inch thick.
c. Liquid, all pipe sizes:
1) Flexible Elastomeric: 1 1/2 inches thick.
d. Hot Gas, all pipe sizes:
1) Flexible Elastomeric: 1 1/2 inches thick.
e. Outdoor Jacketing: Self-Adhering or Removable UV and Vapor protection.
2. Condensate and Equipment Drain Water Below 60 Degrees F:
a. All Pipe Sizes:
1) Glass-Fiber, Preformed Pipe, Type I: 1/2 inch thick.

D. Outdoor, Above Ground Piping:
1. Refrigerant Piping and Tubing:
a. Low Pressure Suction/Vapor (40-90 degrees F), all pipe sizes:
1) Flexible Elastomeric: 1 inch thick.
b. High Pressure Suction/Vapor (95-220 degrees F), all pipe sizes:
1) Flexible Elastomeric: 2 inch thick.
c. Liquid, all pipe sizes:
1) Flexible Elastomeric: 1 1/2 inches thick.
d. Hot Gas, all pipe sizes:
1) Flexible Elastomeric: 1 1/2 inches thick.
e. Outdoor Jacketing: Self-Adhering or Removable UV and Vapor protection.

E. Indoor, Field Applied Jacket:
1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. Piping, exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor):
a. PVC: 20 mils thick.

F. Outdoor, Field Applied Jacket and Covers:
1. Install jacket/covers over all insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
2. Piping, Exposed:
a. Self-Adhering Jacketing: VentureClad, 1579CW/CE - Clear embossed.

END OF SECTION

SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment drains and overflows.

B. Pipe hangers and supports.

C. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 CODE AND PERMIT COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that indicated shall not be substituted.

B. Contractors shall familiarize themselves with all requirements as to permits, fees, etc., and shall comply. All permits, licenses, inspections, and arrangements required for the work shall be provided by the Contractors at their expense.

C. All utilities shall be installed in accordance with utility company rules and regulations.

D. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of piping systems. Wherever practical, install piping as indicated.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

D. ASME B31.9 - Building Services Piping.

E. ASTM A536 - Standard Specification for Ductile Iron Castings.

F. ASTM B32 - Standard Specification for Solder Metal.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

I. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

J. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

K. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

L. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.

M. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

N. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.

O. AWWA C606 - Grooved and Shouldered Joints.

P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.04 SUBMITTALS

A. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalog information.

3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

C. Pipe pressure testing report.

D. Mechanical grooved joint couplings, fittings and specialties shall be shown on shop drawings and product submittals, and shall be specifically identified with the manufacturer’s style or series designation.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this sectionwith minimum 5 years of experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. Coupling Manufacturer:
1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.

F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

G. All grooved joint couplings, fittings and specialties shall be the products of a single manufacturer.
1. Grooving tools shall be of the same manufacturer as the grooved components.
2. All castings used for coupling housings, fittings, etc., shall be date stamped for quality assurance and traceability.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, non toxic synthetic rubber sealing elements..

B. Steel Pipe: ASTM A53/A53M, Schedule 40, black.

2.02 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

C. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

D. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.

F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.

H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

I. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.

J. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

K. Vertical Support: Steel riser clamp.

L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

N. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

O. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

P. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

Q. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

R. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

S. Steel Pipe Saddles:
1. Designed for high temperature service or where heat losses are to be kept at a minimum and to protect insulation against damage at the point of support
2. Conforms with Federal Specification WW-H-171 (Type 40A or 40B), Manufacturers Standardization Society ANSI®/MSS-SP-58 (Type 39)

2.03 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:
1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick, preformed neoprene.
4. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
6. Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

a. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
    1) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    2) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

C. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

D. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Installation-Ready, for direct stab installation without field disassembly or loose parts.
2. Couplings to be bolt pad to bolt pad assembly.
3. Coupling manufacturer’s factory-trained representative shall provide on-site training for the contractor’s field personnel in the proper use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site to ensure best practices in grooved joint installations are being followed.
4. Dimensions and Testing: In accordance with AWWA C606. Couplings shall comply with ASTM F1476 “Standard Specification for the Performance of Gasketed Mechanical Couplings for use in Piping Applications”.
5. Mechanical Couplings: Comply with ASTM F1476.
6. Housing Material: Ductile iron, galvanized complying with ASTM A536.
7. Gasket Material: Prelubricated, grade EHP, EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F. Central cavity pressure-responsive design.
8. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel. ASTM A449.
9. When pipe is field grooved, provide coupling manufacturer's grooving tools.
10. Manufacturers:
    a. Victaulic Company: www.victaulic.com.
11. Grooved Copper Tube Fittings:
    a. Fittings: ASME B16.22 wrought copper and ASTM B 75 (ASTM B 75M), copper tube or ASME B 16.18 and ASTM B 584, bronze casting.
    b. Couplings: Rigid pattern, offsetting angle-pattern bolt pads.
12. Grooved Steel Pipe and Fittings:
    a. Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings.
    b. Rigid Type Couplings: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B3 1.1 and B31.9.
    c. Flexible Type Couplings: Used in locations where vibration attenuation and stress relief are required. Use three flexible couplings in lieu of a flexible connector.

E. Pressed Fittings:
1. Copper Tube:
    a. Copper and copper alloy press fitting shall conform to material requirements of ASME B16.18 or ASME 16.22 AND Performance criteria of IAPMO PS 117.
    b. Sealing elements shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by the fitting manufacturer.
    c. On sizes 1/2" to 4" the fitting shall have a feature that assures leakage of liquids and/or gases from inside the system past the sealed elementof an unpressed

connection. this function feature shall provide an easy indication of an unsealed connection.

F. Dielectric Connections:
   1. **Dielectric unions shall not be used.**
   2. Waterways and Nipples:
      a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      b. Dry insulation barrier able to withstand 600-volt breakdown test.
      c. Construct of galvanized steel with threaded end connections to match connecting piping.
      d. Suitable for the required operating pressures and temperatures.
      e. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F
   3. Flanges:
      a. Dielectric flanges with same pressure ratings as standard flanges.
      b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      c. Dry insulation barrier able to withstand 600-volt breakdown test.
      d. Construct of galvanized steel with threaded end connections to match connecting piping.
      e. Suitable for the required operating pressures and temperatures.
      f. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   4. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.

G. Joining Materials:
   1. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
   2. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
   3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.02 INSTALLATION

A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

B. Provide drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install piping at a uniform grade of 0.2 percent (1 inch in 40 feet) upward in direction of flow.

D. Mechanically formed tees in copper pipe may be formed per ANSI A40 by workers certified after factory authorized training. Branch lines shall be formed with two dimple/depth stops in line with the run of the tube.
   1. Fabricate mechanically formed tees/outlets according to manufacturer's standard written procedure.
   2. Mechanically formed outlets shall have a collar with a height not less than three times the thickness of the branch tube wall.
   3. The branch shall be notched to conform to the inner curve of the run and shall be dimpled or otherwise impeded from penetrating the run pipe/tube to a depth that would obstruct the flow of fluid through the run pipe/tube.
   4. The branch tube shall also be dimpled or otherwise marked to indicate the location of the notches with respect to the run.
   5. Such marking shall be at a sufficient distance from the face of the joint to allow for a visual point of inspection after the joint is brazed.
   6. All joints constructed using this method shall be brazed.

E. Provide non-conducting dielectric connections wherever joining dissimilar metals. **Dielectric unions are not allowed.**

F. Install and support in accordance with manufacturer's instructions.

G. Route piping in orderly manner, parallel to building structure, and maintain gradient.

H. Install piping to conserve building space and to avoid interference with use of space.

I. Group piping whenever practical at common elevations.

J. Sleeve pipe passing through partitions, walls, and floors.

K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

L. Slope piping and arrange to drain at low points.

M. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming off the top of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

N. Anchor piping for proper direction of expansion and contraction.

O. Provide temperature and pressure test fitting (PTT) in accordance with the contract documents and as required to test and balance all equipment.
   1. Provide a pressure/temperature test fitting (PTT) at each water sensor that is an input point to the control system.

P. Piping shall be installed so as to allow removal of ceiling hung equipment.

Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

R. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

S. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
      a. Install and support non-metalic pipe and tubing in accordance with manufacturer's instructions.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
      a. Where trapeze hangers are constructed, the threaded rods supporting the trapeze member shall not extend more than 1" below assembly.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   10. Steel Pipe Saddles:
      a. Provide on all heating hot water piping, operating above 200 degrees F, 3" and larger.

T. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

U. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .

V. Use eccentric reducers to maintain top of pipe level.

W. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

3.03 INCIDENTAL WORK

A. The following incidental work shall be furnished by the Contractor under the supervision of the Temperature Control Contractor:
   1. The Piping Contractor shall install automatic valves and separable wells that are specified to be furnished by the Temperature Control Contractor.
   2. The Piping Contractor shall provide all necessary valved pressure taps, water, drain and overflow connections and piping.
   3. The Piping Contractor shall provide all necessary piping connections required for flow devices, valve position indicators, etc.

3.04 SAFETY VALVE INSTALLATIONS

3.05 EQUIPMENT DRAINS AND OVERFLOW

A. Piping material shall be suitable for type and temperature of drainage and location of equipment. Size piping per manufacturer's requirements and as indicated.

B. Cooling coil condensate drainage shall be copper pipe. Condensate drain piping size (unless indicated otherwise):
   1. Air Handling Units and Rooftop Units:
      a. Less than 30 tons: 1 1/4"
      b. 31 - 50 tons: 1 1/2"

c. 51 - 150 tons: 2"

2. Terminal Cooling, Fan Coil, Blower Coil and Furnaces:
   a. 0 - 5 tons: 3/4"
   b. 6 - 20 tons: 1"

C. Route drains and overflows to nearest floor drain unless shown otherwise. Slope piping to drain at 1/8 inch per foot. Avoid crossing walking paths in mechanical rooms.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. Provide relief valve set at pressure no more than 1/3 higher than test pressure to protect against damage by expansion of liquid or other source of overpressure during the test.
   3. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
   4. Check expansion tanks to determine that they are not air bound and that system is full of water.
   5. Subject piping system to a hydrostatic test pressure which, at every point in the system, is not less than 1-1/2 times the design pressure assuming 125 psi minimum design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve or component on the system under the test.
   6. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
   7. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   8. Prepare written report of testing.

3.07 CLEANING OF PIPING

A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

3.08 SCHEDULES

A. Hanger Spacing for Steel Piping.
   1. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   2. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   3. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   4. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   5. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   6. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   7. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
   8. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
   9. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
   10. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.

B. Hanger Spacing for Plastic Piping.
   1. Per piping manufacturer's requirements and recommendations.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Valves.
E. Strainers.
F. Check valves.
G. Pressure regulators.
H. Pressure relief valves.
I. Filter-driers.
J. Solenoid valves.
K. Expansion valves.
L. Receivers.
M. Flexible connections.
N. Engineered wall seals and insulation protection.

1.02 CODE AND PERMIT COMPLIANCE

A. Work shall be in accordance with all applicable codes. Where the codes and drawings do not agree, the code shall take precedence; however, code shall take precedence over what is shown only when it is more stringent than that indicated. Items that are allowed by codes which are less stringent than that shown on the Drawings shall not be substituted.
B. Contractors shall familiarize themselves with all requirements as to permits, fees, etc., and shall comply. All permits, licenses, inspections, and arrangements required for the work shall be provided by the Contractors at their expense.
C. All utilities shall be installed in accordance with utility company rules and regulations.
D. Drawings, plans, and schematics and diagrams indicate the general location and the arrangement of piping systems. Wherever practical, install piping as indicated.

1.03 REFERENCE STANDARDS

A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers.
B. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers.
C. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.
E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.
F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
G. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
H. ASME B31.9 - Building Services Piping.
I. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

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

N. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.

O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

P. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

Q. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials.

R. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

S. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

T. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

U. UL 429 - Electrically Operated Valves.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Filter-Dryer Cartridges: One of each type and size.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME BPVC-IX.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.02 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
   1. Alternate Fittings: ASTM-B75 or B743, Flame-Free, copper-to-copper fittings for connecting copper-to-copper refrigerant piping.
      a. 700 psi rated at 250 degrees F.
      b. HNBR O-Ring.
      c. ETL tested to UL 207 and ETL listed.
      d. UL Listed: 207, SA#33958, SDTW(7) (Except where noted)
      e. ASHRAE-15, ANSI 15, ASME B31.5, ANSI 31.5 approved.

B. Pre-Insulated Piping Line Sets:
   1. Copper Tube: Seamless, H58 hard drawn or O60 soft annealed.
      a. Maximum Operating Pressure: 700 psi at 250 degrees F.
      b. Joints: Flared or Braze, BCuP silver/phosphorus/copper alloy.
   2. Insulation:
      a. General:
         1) 1" minimum thickness, provide applicable code required thickness.
         2) ASTM E84 25/50 flame/smoke index.
         3) K Value: 0.25 at 75 degrees F.
         4) Moisture Vapor Permeability: 0.05 perm inch.
         5) Maximum Service Temperature: 220 degrees F.
         6) Minimum Service Temperature: Minus 40 degrees F.
         7) Use molded tubular material wherever possible.
      b. Flexible Elastomeric:
         1) Insulation: UV coated, preformed flexible elastomeric cellular rubber insulation, Grade 1;
            (a) Connection: Waterproof vapor barrier adhesive.
      c. Polyethylene:
         1) Insulation: Flexible closed-cell polyethylene tubing.
            (a) Connection: Contact adhesive.

C. Pipe Supports and Anchors:
   1. Provide hangers and supports that comply with MSS SP-58.
      a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Conform to ASME B31.5.
   3. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel adjustable swivel, split ring.

4. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.03 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 700.

2.04 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.05 VALVES

A. Diaphragm Packless Valves:
   1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Angle Valves:
   1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Ball Valves:
   1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:
   1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.06 STRAINERS

A. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.07 CHECK VALVES

A. Globe Type:
   1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 500 psi.

B. Straight Through Type:
   1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 250 degrees F.

2.08 PRESSURE REGULATORS

A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.09 PRESSURE RELIEF VALVES

A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected toASHRAE Std 15, with standard setting of 450 psi.

2.10 FILTER-DRIERS

A. Performance:
   1. Flow Capacity - Liquid Line: Rated in accordance with ARI 710.
   2. Flow Capacity - Suction Line: Rated in accordance with ARI 730.
   3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
   4. Design Working Pressure: 350 psi, minimum.

B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

C. Construction: UL listed.
   1. Connections: As specified for applicable pipe type.

2.11 SOLENOID VALVES

A. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.

B. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.12 EXPANSION VALVES

A. Angle or Straight Through Type: AHRI 760 (I-P); design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.13 ELECTRONIC EXPANSION VALVES

A. Valve:
   1. Brass body with flared or soldered connection, needle valve with floating needle and machined seat, stepper motor drive.

B. Evaporation Control System:
   1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.

C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.14 RECEIVERS

A. Internal Diameter 6 inch and Smaller:

1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.

B. Internal Diameter Over 6 inch:
1. AHRI 495, welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.15 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

2.16 ENGINEERED WALL SEALS AND INSULATION PROTECTION

A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Outlet Cover Color: Gray.
2. Water Penetration: Comply with ASTM E331.
3. Air Leakage: Comply with ASTM E283/E283M.
4. Air Permeance: Comply with ASTM E2178.

B. Insulation Protection System: Mechanical line insulation and PVC cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
5. Flame Spread and Smoke Development Rating of 25/450: Comply with ASTM E84.
6. Adhesive free.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.5.
2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
    a. Where trapeze hangers are constructed, the threaded rods supporting the trapeze member shall not extend more than 1" below assembly.
7. Provide copper plated hangers and supports for copper piping.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Flood piping system with nitrogen when brazing.

K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. See Section 09 9123.

M. Insulate piping and equipment; refer to Section 230719 and Section 23 0716.

N. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

P. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

R. Fully charge completed system with refrigerant after testing.

S. Provide electrical connection to solenoid valves. See Section 26 0583.

T. Below ground, install copper tubing in protective PVC conduit. Vent conduit outdoors. Refrigerant suction lines shall be heat traced with electric heat tape as required by equipment manufacturers. Provide power supply separate from compressor.

U. Route and size piping per manufacturer's requirements. Submit piping diagrams for review prior to installation.

V. Provide hot gas bypass on coils where indicated. Bypass shall include isolation valve, solenois valve to open with liquid line solenoid, and suction pressure regulating valve.

W. Install permanent liquid line filter drier on systems up to 15 tons, replaceable cartridge type on systems larger than 15 tons.
1. Install 3-valve bypass around replaceable filter drier. Provide one set of replaceable catridges for each filter drier installed.

3.03 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

3.04 SCHEDULES

A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.

3.05 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
2. Check compressor oil level above center of sight glass.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves, except bypass valves that are used for other purposes.
5. Check compressor-motor alignment, and lubricate motors and bearings.

E. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

3.06 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter-dryer after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION

SECTION 23 8129
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air-source outdoor units.

B. Refrigerant piping.

C. Refrigerant branch units.

D. Indoor units.

1.02 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

B. AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.

E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants.

F. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

G. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

H. ITS (DIR) - Directory of Listed Products.

I. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

J. NFPA 70 - National Electrical Code.

K. UL 1995 - Heating and Cooling Equipment.

L. UL 508 - Industrial Control Equipment.

M. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 SUBMITTALS

A. Specification Compliance Review.

B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.

C. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:

1. Outdoor Units:
    a. Refrigerant Type and Size of Charge.
    b. Output and Input Cooling Capacity: Btu/h.
    c. Output and Input Heating Capacity: Btu/h.
    d. Operating Temperature Range, Cooling and Heating.
    e. Fan Capacity: Flow in cfm with respective fan curves.
    f. External Static Pressure (ESP): In-wc.
    g. Sound Pressure Level: dB(A).
    h. Electrical Data: Complete including motor size.
    i. Maximum number of indoor units that can be served.
    j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).
    k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.

2. Indoor Units:
    a. Output and Input Cooling Capacity: Btu/h.
    b. Output and Input Heating Capacity: Btu/h.
    c. Fan Capacity: Flow in cfm with respective fan curves.
    d. External Static Pressure (ESP): In-wc.
    e. Electrical Data: Complete including motor size.
    f. Maximum Lift of Built-in Condensate Pump.
3. Control Panels: Complete data of controllers, input-output points, and zones.

D. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
2. Condensate piping routing, size, and pump connections.
3. Detailed power wiring diagrams.
4. Detailed control wiring diagrams.
5. Locations of required access through fixed construction.
6. Drawings required by manufacturer.

E. Design Data:
1. Provide design calculations showing that system will achieve performance specified.
2. Provide design data with respective calculations for respective climate zone in accordance with ASHRAE Std 90.1 I-P, ASHRAE Std 15, and ASHRAE Std 34.

F. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
3. Identification of replaceable parts and local source of supply.

G. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
2. Locations of access panels.
3. Locations of control panels.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Daikin: www.daikinac.com/.

B. LG Electronics U.S.A., Inc: www.lghvac.com/.

C. Mitsubishi Electric Trane HVAC US, LLC: www.metahvac.com/.

2.02 VARIABLE REFRIGERANT FLOW SYSTEM

A. Minimum System Requirements:
   1. System Testing, Capacity Rating, and Performance:
      a. AHRI 1230 when cooling capacity is equal or greater than 65,000 Btu/h.
      b. AHRI 210/240 when cooling capacity is below 65,000 Btu/h.
   2. Safety Certification: Bear UL 1995 tested and ITS (DIR) listed certification label.
   3. Outdoor Units: Furnish installation and surface support hardware products in accordance with ASCE 7 for wind restraint.

B. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
   1. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7.
      a. System shall reduce compression ratio only when/if all indoor units are within 1.8F of setpoint (adjustable).
      b. PERFORMANCE, CAPACITIES AND CHARACTERISTICS
         1) See Drawings for Equipment Schedules with Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

C. System Controls:
   1. Manufacturer's user interface tablet.

D. Refrigerant Piping:
   1. Insulate each refrigerant line, per applicable codes and operating temperature ranges.
      a. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.
      b. Variable evaporator temperature shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand.

2.03 AIR-SOURCE OUTDOOR UNITS

A. Heat Pump Type:
   1. DX refrigeration unit piped to one or more compatible indoor units either directly or indirectly through one or more intermediate refrigeration branch units.
   2. Manifold two or to three units as recommended by manufacturer to handle sequencing and coordination of multiple indoor units.

B. Unit Cabinet:
   1. Capable of being installed with wiring and piping to the left, right, rear or bottom.
   2. Designed to allow side-by-side installation with minimum spacing and vibration isolation.
   3. Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
   4. Sound Pressure Level: 55 dB measured at 3 feet from front of unit.

C. Heat Sink Side:
   1. Condenser Fans:
      a. Provide minimum of 2 fans for each condenser within the outdoor unit.
      b. Minimum External Static Pressure: Factory set at 0.12 in-wc.
      c. Fan Type: Vertical discharging, direct-driven propeller type with variable speed operation using DC-controlled ECM motors mechanically connected using permanently lubricated bearings having whole assembly protected with fan guards.
   2. Condenser Coils:
      a. Hi-X seamless copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.

D. Refrigeration Side:
   1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).

2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
3. Refrigerant: Factory charged. Controller to alarm when charge is below capacity.
4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.
9. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.

E. Local Controls:
1. Include factory-wired instruments, sensors, switches, and safeties for unit control.
2. Configured to coordinate internal unit operation with remote indoor units and with built-in capacity to coordinate other manifolded outdoor units and remote refrigerant branch unit(s).
3. Include screen and button interface to setup operating schedules, setpoints, alarms, and remote unit setpoint coordination. Also used for system troubleshooting.
4. Self diagnostic, auto-check functions to detect malfunctions and display the type and location.

F. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet IP.

G. Power:
1. Outdoor Mounted: Provide fused NEMA EN 10250 Type 4X disconnect switch.
2. Interior Mounted: Provide fused NEMA EN 10250 Type 1 disconnect switch.

2.04 REFRIGERANT PIPING

A. Two-Pipe Run: Provide low-pressure vapor and high-pressure vapor gas pipes for each indoor unit selected for seasonal heating or cooling service.

B. Three-Pipe Run: Provide low-pressure vapor, high-pressure vapor gas, and liquid pipes for each indoor unit selected for off-season heating and cooling changeover service.

C. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

2.05 REFRIGERANT BRANCH UNITS

A. Outdoor unit interface to handle two or more indoor units required to do automatic off-season heating and cooling changeover.

B. Concealed box consisting internally-piped refrigeration loops, subcooling heat exchanger, and other devices coordinated by electronic valves to facilitate off-season load management between outdoor and indoor units.

C. Minimum Requirements:
1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise;

use of multi-port branch selector boxes is not permitted unless spare ports are provided for redundancy.

2. Provide one electronic expansion valve for each downstream indoor unit served except when multiple indoor units are connected, provide balancing joints in downstream piping to keep total capacity within branch unit capacity.
3. Energize subcooling heat exchanger during simultaneous heating and cooling service.
4. Casing: Galvanized steel sheet with flame and heat resistant foamed polyethylene sound and thermal insulation.
5. Refrigerant Connections: Braze type.
6. Condensate Drainage: Provide unit that does not require condensate drainage.

2.06 INDOOR UNITS

A. Minimum Unit Requirements:
   1. DX Evaporator Coil:
      a. Copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
      b. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch and flare end-connections.
      c. Provide thermistor on liquid and gas lines wired into local controller.
      d. Refrigerant circuits factory-charged with dehydrated air for field charging.
   2. Fan Section:
      a. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
      b. Thermally protected, direct-drive motor with statically and dynamically balanced fan blades.
      c. Minimum-adjustable external static pressure 0.32 in-wc; provide for mounting of field-installed ducts.
   3. Local Unit Controls:
      a. Temperature Control: Return air control using thermistor tied to computerized Proportional-Integral-Derivative (PID) control of superheat.
      b. Temperature Zones:
         1) Single Indoor Unit: Set served space(s) as the local temperature zone.
         2) Multiple Indoor Units: For large zones, group and coordinate related indoor units with served spaces as the local temperature zone with each indoor unit as sub-zone.
   4. Return Air Filter:
   5. Condensate:
      a. Built-in condensate drain pan with PVC drain connection for drainage.
      b. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
      c. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.
   6. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

B. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
   1. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
      a. Drain Pan:
         1) Construct of ABS plastic, HDPE, stainless steel, or other corrosion-resistant material and flame rated in accordance with UL 94 when using polymers.
         2) Slope on two planes to pitch condensate to drain connection, include secondary drain.
         3) Float Switch: UL 508, rated for protection against condensate overflow, controller connected.
         4) Provide an auxilary drain pan, slightly larger than the primary drain pan.

C. Ceiling-Recessed Cassette, Indoor Units:
   1. Ceiling mount, 4-way, 2-way, or 1-way supply air flow units with central return air grill, DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
   2. Cabinet Height: Maximum of 10 inches above face of ceiling.
   3. Exposed Housing: White, impact resistant, with washable decoration panel.
   4. Supply Airflow Adjustment:
      a. Horizontally and vertically adjustable dampers with electronic actuators.
      b. Four-way distribution field-modifiable to 3-way and 2-way airflow.
      c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
   5. Return Air Filter: Manufacturer's standard.
   6. Sound Pressure Range: Between 28 to 33 dB(A) at low speed measured at 5 feet below the unit.
   7. Fan: Direct-drive turbo type, with motor output range of 1/16 to 1/8 hp.
   8. Condensate Pump: Built-in with minimum lift of 21 inches.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping in accordance with equipment manufacturer's instructions.

C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

D. Coordinate with installers of systems and equipment connecting to this system.

E. Refrigerant Piping: See Section 23 2300 with Section 23 0719 for insulation, and follow 23 2300 for piping hanger support or specific manufacturer recommendations.

F. Connect indoor units to condensate piping.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide manufacturer's field representative to inspect installation prior to startup.

3.03 SYSTEM STARTUP

A. Provide manufacturer's field representative to perform system startup.

B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.04 CLEANING

A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.

SECTION 26 0400
COMMON REQUIREMENTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. This section describes the general requirements of these specifications and shall apply to all phases of the work specified, shown on the drawings, or required to provide for complete installation of all systems for this project.

B. This Section includes basic materials and methods to complement other Division 26 Sections.

1.02 WARRANTIES

A. Warrant materials, workmanship and equipment against defects for a period of one year after the date of substantial completion.

B. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those divisions of the Project Manual.

C. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warranty period.

D. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner.

E. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project.

F. The repair of faulty workmanship shall be considered to be included in the contract.

1.03 ALTERNATES

A. Alternates, if required, shall be as described in the “Alternates” section of this Project Manual, as described on the proposal form, or as indicated on the drawings.

1.04 QUESTIONS OF INTERPRETATION DURING BIDDING PHASE

A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect for clarification.

B. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date.

C. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents.

D. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

E. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.05 CONTRACT DOCUMENT DISCREPANCIES

A. If any ambiguities should appear in the contract documents, request clarification from the Architect before proceeding with the work.

B. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect.

C. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect was requested and obtained before submission of proposed methods or materials.

D. The Architect shall be the sole judge regarding interpretations of conflicts within contract documents.

1.06 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:
   1. Architect: Architect or Engineer
   2. Code: Applicable national, state and local codes
   3. Mechanical: Plumbing and HVAC work required by the Contract Documents
   4. Electrical: Electrical work required by the Contract Documents
   5. Contractor: Any Contractor performing work required by the Contract Documents
   6. Indicated: Noted, scheduled or specified
   7. Selected: Selected by the Architect.
   8. Provide: Furnish, install, connect and tested complete and ready for use
   9. Furnish: Supply and deliver to the site ready for installation
   10. Install: Install complete, per Contract Documents and manufacturer's requirements.
   11. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
   12. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
   13. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
   14. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
   15. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
   16. Dry Locations: A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.
   17. Damp Locations: Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture.
      a. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold storage warehouses.
   18. Wet Locations: Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

1.07 SYMBOLS

A. Items of equipment and materials are indicated on the drawings in accordance with the symbols on the plans.

1.08 ABBREVIATIONS

A. Refer to abbreviations list on the Drawings.

B. The following abbreviations apply throughout the Contract Documents:
   1. ADA: Americans with Disabilities Act
   2. ANSI: American National Standards Institute
   3. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
   4. ASME: American Society of Mechanical Engineers
   5. ASTM Specification: Standard specifications of the American Society for Testing Materials
   6. FM: Factory Mutual Engineering Corporation
   7. IRI: Industrial Risk Insurers
   8. NEC: National Electrical Code, latest edition
   9. NEMA: National Electrical Manufacturers Association
   10. NFPA: National Fire Protection Association

11. UL or Underwriters: Underwriters Laboratories, Inc.

1.09 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. The work shall conform to all applicable sections of currently adopted editions of the following codes, standards, and specifications:
   1. International Building Code (IBC)
   2. International Fire Code (IFC)
   3. International Energy Conservation Code (IECC)
   4. Safety and Health Regulations for Construction
   5. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards
   6. National Electrical Code (NEC)
   7. National Electrical Safety Code (NESC)
   8. National Fire Protection Association (NFPA)
   9. Life Safety Code (NFPA 101)
   10. Factory Mutual Global Engineering (FMG)
   11. Underwriters' Laboratories, Inc. (UL)
   12. National Electrical Manufacturers Association (NEMA)
   13. Institute of Electrical and Electronics Engineers (IEEE)
   14. Insulated Power Cable Engineers Association (IPCEA)
   15. Telecommunications Industry Association (TIA)
   16. Building Industry Consulting Service International (BICSI)
   17. Applicable national, state and local codes

C. Where there is a conflict between the code and the Contract Documents, the code shall have precedence only when it is more stringent than the Contract Documents.
   1. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.10 PERMITS

A. The Contractors shall familiarize themselves with requirements regarding permits, fees, etc., and shall comply with them.

B. Permits, licenses, inspections and arrangements required for the work shall be obtained by the Contractor at his expense.

C. Utilities shall be installed in accordance with the local rules and regulations.

1.11 MATERIALS AND EQUIPMENT MANUFACTURERS

A. Options in selecting materials and equipment are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced on previous construction projects.

B. Materials and equipment shall be provided in accordance with the following:
   1. Primary Design Products: Primary design products are those products around which the project was designed in terms of capacity, performance, physical size and quality.
   2. Primary design products are indicated by use of a single manufacturer's name, model number or similar data on drawings or schedules or within the specifications.
   3. Provide primary design products unless substitutions are made in accordance with the following paragraphs.
   4. Acceptable Equivalent Substitutions: Acceptable equivalent substitutions are products of manufacturers other than those listed for the primary design products. Equivalent acceptable substitutions shall meet each of the following requirements:
      a. The product shall be manufactured by one of the acceptable manufacturers listed in the Project Manual, drawings, or addenda.

b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance, and physical characteristics.
c. The Contractor providing the substitution shall bear the total cost of changes due to substitutions. These costs may include additional compensation to the Architect for redesign and evaluation services, increased cost of work by the Owner or other Contractors, and similar considerations.

5. Performance Requirements: Where the contract documents list performance requirements or describe a product or assembly generically, provide products that comply with the specific requirements indicated and that are recommended by the manufacturer for the respective application.
6. Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations.

C. Proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, delivery time requirements, and the availability of repair or replacement parts may also be considered.

D. The Architect shall be the sole and final judge as to the suitability of substitution items.

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples:
1. Other sections in the Project Manual shall be adhered to if more stringent than the following paragraphs.
2. When required by other sections of this Project Manual, submit shop drawings, product data or samples to the Architect for review.
3. Submittals deemed unnecessary by the Architect shall be returned indicating “No Action Taken”.
4. A completed copy of the transmittal form included with the Project Manual shall accompany each submittal.
5. Submittals shall be numbered consecutively.
6. Unless otherwise noted, submit one copy electronically of shop drawings and product data for review. Review comments will be returned electronically. A hard copy of the electronic submittal will be returned if requested.
7. Where samples are required, submit one (1) sample of each required item.
8. Shop drawings are drawings, diagrams, schedules and other data specifically prepared for this project by the Contractor, Manufacturer, Supplier, or Distributor to illustrate some portion of the work. Shop Drawings shall also detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
   a. Shop drawings shall be drawn to accurate scale and of adequate size to illustrate required details.
9. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams and other information furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate a material, product or system for some portion of the work.
10. Samples are physical examples furnished by the Contractor, Manufacturer, Supplier, or Distributor to illustrate materials, equipment or workmanship and to establish the standards by which the work will be performed.
11. Each submittal shall clearly indicate proposed items, capacities, characteristics and details in conformance with contract documents. Equipment items shall be marked with the same item number as used on drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
12. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect.

13. When required by other sections of this Project Manual, the Contractor shall submit a Specification Compliance Review consisting of a paragraph-by-paragraph review of the specifications and addenda with the following marked for each paragraph. Markings may be made in the margins of the original specification or addenda. Unless a deviation or exception is specifically noted in the Specification Compliance Review, it is assumed that the equipment, product, or material is in complete compliance with the contract documents. Submit Specification Compliance Review with shop drawings and product data.
    a. “C”: Comply with no exceptions.
    b. “D”: Comply with minor deviations. For each deviation, provide the reasons for the deviation and how the intent of the specification can be satisfied.
    c. “E”: Exception. Equipment, product, or material does not comply. For each exception, provide reasons for the exception, and suggest possible alternatives for the Owner’s consideration.
    d. “N/A”: The paragraph does not apply to the proposed equipment, product, or material.
14. The Architect shall review or take other appropriate action upon the Contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.
15. Contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect's review of shop drawings, product data or samples.
16. Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect's review of those drawings.
17. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been reviewed by the Architect. Such portions of the work shall be in accordance with reviewed submittals.
18. The successful Contractor/Supplier may, at their option, obtain DXF or AutoCad DWG electronic drawing files for use in preparation of shop drawings.
    a. This information is available from Alvine upon written request.
    b. A non-refundable handling charge of $10.00 per drawing file requested will be required at the time of receipt of the electronic files.
    c. The use of these drawing files is intended solely for the preparation of drawings as required by these contract documents.
    d. Any other use is strictly prohibited by copyright laws.
    e. The user of these electronic drawing files assumes full responsibility for their accuracy and scale.

B. Operation and Maintenance Manuals:
1. Prepare three (3) operation and maintenance manuals for the equipment furnished. Manuals shall be submitted to the Architect for review and distribution to the Owner not less than 30 days prior to substantial completion of the project. Manuals not meeting the following requirements may be rejected by the Architect.
2. Each manual shall be assembled in a three-ring binder with hard cover and plastic finish. Binders shall not exceed a 3-inch thickness. Where more than one binder is required, the manuals shall be separated into a logical grouping, i.e., “Mechanical”, “Electrical”, “Maintenance”, “Operation”, “Parts”, Shop Drawings”, etc. Each binder shall have the following information clearly printed on its front cover:
    a. Project name and address.
    b. Portion of the work covered by each volume (if more than one volume in the set). Where more than one volume is required, label each volume as “Volume _____ of _____”.
    c. Name, address and telephone number of Contractor and Sub-Contractors including night or emergency number.
3. Manual shall include, but shall not be limited to, the following:

a. A Complete Index. Contractor may submit the index to the Architect for review prior to submittal of complete manuals if desired.
b. Names, Addresses and Telephone Numbers. This list shall include the manufacturer and local representative who stocks or furnishes repair parts for all items of equipment and shall be typed on a single page in front of the binder.
c. Startup, Operation and Shutdown Procedures. Provide a written description of procedures for startup, operation and shutdown of each electrical item or system. This description shall include switches to operate, buttons to push, etc., in proper sequence, and the location of switches, starters, and pushbuttons. Description shall include item references or labels used in the contract documents unless otherwise instructed in advance by the Owner.
d. Equipment Accessory Schedule. Upon completion of the work, furnish the Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required and the manufacturer of renewable items.
e. Manufacturer's Operation and Maintenance Manuals and Parts Lists.
f. Emergency Procedures. Provide a written description of emergency operating procedures or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency services to the various parts of the system.
g. One copy of shop drawings and product data, clearly marked for each item furnished using the designation label specified or indicated on Drawings.
h. Manufacturers' warranty information.
i. Normal Maintenance Schedule. Include a listing of work to be performed at various time intervals; i.e., 30, 90, 180 days and yearly.

1.13 OPERATING TRAINING

A. Complete operating instructions for each system and item of equipment shall be provided to the Owner's designated personnel.

B. Operation and Maintenance Manuals must be reviewed and accepted by the Architect and provided to the Owner prior to operating training.

C. Training shall be scheduled at the convenience of the Owner. A minimum of 4 hours of training shall be provided.

D. Training shall include instructions on the following:
1. Startup and shutdown procedures
2. Periodic maintenance
3. Emergency operation
4. Safety

E. In addition to the instructions required above, wherever possible perform the operations being described in order to fully illustrate system operation.

F. At the completion of training, turn over to the Owner required keys and special tools for installed equipment. Each key or tool shall be labeled with its use.

1.14 QUALITY ASSURANCE

A. Conform to the requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.15 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment.
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Coordinate electrical service connections to components furnished by utility companies.
1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

F. Coordinate electrical testing of electrical, mechanical, or architectural items so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

G. Provide offsets and elevation changes in conduit and cable tray as required to complete the Layout and Coordination Process.

1.16 STRUCTURAL COORDINATION

A. In cases where the Contractor determines that superimposed loads such as suspended or floor mounted electrical system or equipment exist which exceed design loads indicated on structural contract documents, Contractor shall submit load data to Architect for review prior to proceeding with work.

B. Distribute the maximum load hung from any structural member for mechanical, electrical, plumbing, ductwork, piping, etc. over the member's tributary area in a way that the design superimposed dead loads listed in structural contract documents are not exceeded. The Contractor shall coordinate the loads and provide additional support or distribution framing as required achieving the allowable load distribution.

C. Connections of systems designed by Contractor's engineer such as, but not limited to mechanical, electrical, plumbing loads are assumed to impose vertical and/or horizontal loads on the base building structural members without generating torsion in the supporting structural members. Contractor is responsible for furnishing and installing all supplementary bracing members as required to prevent torsion on the base building structure.

PART 2 PRODUCTS

2.01 PERFORMANCE, CAPACITIES AND CHARACTERISTICS

A. See Drawings for Equipment Schedules for Equipment Performance Requirements when capacities and characteristics are not indicated in the specifications.

2.02 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. Where the National Electrical Code or applicable codes require equipment to be marked with a Short Circuit Current Rating (SCCR), the equipment shall be manufactured as required such that the SCCR of the equipment meets or exceeds the available short circuit current at the equipment. Acceptable methods of complying with this requirement are as follows:
1. Provide SCCR rating at the equipment that meets or exceeds the available short circuit current at the switchboard or panelboard where the equipment circuit originates.

2. Provide calculations, based on the available short circuit current at the switchboard or panelboard where the equipment circuit originates, that document the actual short circuit current available at the equipment. The SCCR rating of the equipment shall meet or exceed this calculated value.

2.03 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.04 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details and requirements.

2.05 QUANTITY OF SPECIFIED ITEMS REQUIRED

A. Wherever in these specifications an article, device or piece of equipment is referred to in the singular number; such reference shall apply to as many such articles as are shown on the drawings or required to complete the installation.

2.06 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.07 BACKFILL MATERIAL AND MIXES

A. Earth Fill: Approved type of soil classified, in accordance with ASTM D2487, as GW, GP, GM, GC, SW, SP, SM. SC, ML or CL, and free of foreign substances, obtained from excavation on this project or other approved source, and having a plasticity index between 7.5 and 17.

B. Granular Fill: Granular fill shall include clean, natural or prepared gravels, gravel-sand mixtures, sands or gravelly sands with little or no fines. A minimum of 95% shall be retained on a No. 200 sieve.

C. Pea Gravel: Pea gravel shall consist of clean, hard, round particles of crushed stone, crushed or uncrushed gravel with the following gradation:

Sieve Size	Percent Passing
3/8 inch	85 - 95
#4	55 - 15
#8	0 - 2

D. Crushed Rock: Crushed rock shall consist of clean, hard, particles of crushed limestone, dolomite, granite, quartzite, or other approved rock. It shall have a percentage of wear of not more than 45 and a percent loss of not more than 30 at the end of 16 cycles of the freezing and thawing test. Gradation for crushed rock shall be as follows:

Sieve Size	Percent Retained
1-1/2 inch	0
3/4 inch	5 - 35
3/8 inch	30 - 64
#10	70 - 90
#200	90 - 100

PART 3 EXECUTION

3.01 GENERAL

A. Fabrication, erection, and installation of the complete electrical system shall be done by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project.

B. Check areas and surfaces where electrical equipment or materials are to be installed and report any unsatisfactory conditions before starting work.

C. Commencement of work signifies the Contractor's acceptance of the conditions as fit and proper for the execution of the electrical work.

D. Install equipment and systems in accordance with manufacturer's instructions, requirements, or recommendations.

E. Comply with NECA 1.

F. Unless otherwise noted, measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

G. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

H. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

I. Right of Way: Give to raceways and piping systems installed at a required slope.

J. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.02 DELIVERY AND STORAGE OF MATERIALS

A. Make provisions for the delivery and safe storage of materials. Make the required arrangements with other contractors for the introduction into the building of equipment too large to pass through finished openings.

B. Materials shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected.

C. Adequately protect supplies and equipment during cold weather.

D. Protect items subject to cold weather damage by covering, insulating, or storing in a heated space.

3.03 COOPERATION WITH OTHER CONTRACTORS

A. Perform the electrical work in conformance with the construction called for by other trades and afford other contractors reasonable opportunity for the execution of their work.

B. Properly connect and coordinate the electrical work with the work of other contractors at such time and in such a manner as not to delay or interfere with their work.

C. Examine the contract documents for the General, Mechanical, and Electrical work and the work of other trades. Coordinate work accordingly.

D. Promptly report to the Architect any delay or difficulties encountered in the installation of the electrical work which might prevent prompt and proper installation of work required from other trades.

3.04 COORDINATION OF WORK

A. Plan work so it proceeds with a minimum of interference with other trades.

B. Inform the General Contractor of all openings required in the building construction for the installation of the electrical work.

C. Cooperate with other contractors in furnishing material and information, in proper sequence, for the correct location of sleeves, inserts, foundations, wiring, etc.

D. Make provisions for special frames, openings, and sleeves as required.

E. The Electrical Contractor shall pay for extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

3.05 LAYING OUT WORK

A. Carefully lay out work in advance of installation using data and measurements from the site, the appropriate civil, architectural, and structural drawings, and shop drawings.

B. Confirm code required clearances.

C. Do not infringe upon space required for operation, maintenance, or clearance for items installed by other contractors.

D. Prior to installation of any work, make certain the location does not conflict with other items in or near the same location.

E. If the layouts so prepared indicate that the required conditions cannot be met in the space provided, inform the Architect prior to installation and request clarification.

F. Failure to properly coordinate and lay out work will require correction by the Contractor at the Contractor's expense

3.06 DATA AND MEASUREMENTS

A. Mechanical and Electrical drawings are diagrammatic or schematic. Do not scale drawings.

B. The data given herein and on the drawings is as accurate as could be secured; absolute accuracy is not guaranteed.

C. Obtain exact locations, measurements, levels, etc., at the site and adapt their work to actual conditions.

D. Examine the General Construction, Mechanical, Electrical, and other applicable drawings and the Specifications.

E. Utilize only Architectural drawings, Structural drawings, and site measurements in calculations.

F. Layout and coordinate work prior to installation to provide clearances for operation, maintenance and codes. Verify non-interference with other work.

G. Locate outlets and devices mounted on finished surfaces with regard to paneling, furring, trim, etc.

H. Install outlets and devices with vertical edges of plates plumb.

I. Install boxes or plaster rings such that the front edge extends to the finished surface of the wall, ceiling or floor without projecting beyond the surface.

J. Install receptacles, switches, etc., on wood trim, cases, or other fixtures symmetrically and, where necessary, install with the long dimension of the plate horizontal.

K. Coordinate locations of outlets and devices with other contractors so as not to destroy the aesthetic effect of the surface in which the outlets and devices are mounted. Coordinate the locations of electrical items with work furnished by other trades to avoid interference.

L. Heights of outlets are measured from finished floor to centerline of device.

M. Adjust heights as necessary to clear wall-mounted cabinets, fin tube convectors, unit heaters, etc.

N. Mounting heights shall be in compliance with ADA requirements.

O. Install outlets at the heights indicated below unless otherwise noted.
   1. Wall switches: 46 inches.
   2. Receptacle outlets (general): 18 inches.
   3. Receptacle outlets (kitchen, utility room, workbenches, etc.): 46 inches.
   4. Communications outlets: 18 inches.
   5. Communications outlets (wall phones): 46 inches.
   6. TV outlets: 18 inches.
   7. Pushbuttons: 46 inches.
   8. Clock outlets: 98 inches when possible Allow space below ceiling to service or replace. Above doors, center between door trim and ceiling.

9. Bells, buzzers, chimes: 8 inches below ceiling (field verify with Architect unless noted otherwise).
10. Exit lights: 4 inches between top of door frame and bottom of exit sign where possible.

P. The mounting heights of disconnect switches, circuit breakers, motor controllers, pushbutton stations and other similar devices and equipment may vary depending upon location and whether individually or group mounted.

Q. For convenience and safety, mount equipment with the center of operating levers, handles or buttons no more than 72 inches above the finished floor.

R. Locate individual devices or pieces of equipment, unless otherwise specified, so the operating handle, lever or button is located approximately 5 feet above finished floor. Coordinate heights of electrical items with work furnished by other trades to avoid interferences.

S. Improperly located devices or outlets shall be relocated by the Contractor at the Contractor's expense including necessary patching.

3.07 PROTECTION OF APPARATUS

A. Take necessary precautions to properly protect apparatus, fixtures, appliances, material, equipment, and installations from damage.

B. Failure to provide such protection to the satisfaction of the Architect shall be sufficient cause for the rejection of any particular piece(s) of material, apparatus, equipment, etc., concerned.

3.08 SLEEVE INSTALLATION

A. Coordinate sleeve selection and application with selection and application of firestopping.

B. Concrete Slabs and Walls: Install sleeves during erection of slabs and walls. Space sleeves a minimum of three sleeve diameters on center, unless otherwise noted. Sleeves are not required for core-drilled penetrations.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Sleeves through walls: Install flush with both surfaces of wall.

E. Sleeves through floors: Extend 2 inches above finished floor.

F. Sleeves through roofs: Seal with flexible boot-type flashing units applied in coordination with roofing work

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceways or cable unless sleeve seal is to be installed.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Underground, Exterior-Wall Penetrations: Size sleeves to allow for appropriate clear space between raceway and sleeve for sleeve seals.

3.09 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to maintain fire-resistance rating of assembly.

3.10 WORK IN EXISTING BUILDINGS

A. Execute work in the existing building, indicated on the drawings or specified herein, with a minimum amount of interference with the normal activities of the occupants of the building.

B. Schedule work in advance with the Owner and proceed only with the Owner's written approval.

C. Utilities:
1. Do not interrupt utilities without the Owner's prior written approval regarding the time and duration of such interruptions.

2. Do not disconnect utilities to existing facilities until new or temporary facilities are installed except for short periods of interruption which are necessary for the performance of the new work and which are approved by the Owner.
3. Storm water may be temporarily diverted to surface drainage provided such drainage is arranged to prevent flooding of structures, basements and excavations for construction.

D. Owner's Right to Direct Work: The Owner shall have the right to direct the places of beginning work, its prosecution, and the manner in which all work under this contract is to be conducted, insofar as may be necessary to secure the safe and proper progress and quality of the work.

E. Existing Conduits or Electrical Equipment:
1. Remove or relocate, as required, or as directed by the Architect, existing conduit or electrical equipment which would interfere with the proper installation of new work.
2. Modify existing work in conformance with these specifications.
3. Use the same materials as for new work unless otherwise specified.

3.11 DEMOLITION AND REMODEL

A. Protect existing electrical equipment and installations indicated to remain.

B. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

C. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

D. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

E. Remove demolished material from Project site.

F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

G. Remove existing lights, receptacles, switches, etc., indicated on plans or which are not indicated but must be removed to accommodate demolition or new remodeling.

H. Where existing walls are indicated to be removed, disconnect power to electrical devices and associated appurtenances relating to the walls.

I. Maintain circuit continuity up and down stream from removed outlets.

J. Extend circuiting to up and downstream devices and reconnect as required.

K. Where existing site lighting fixtures are removed, verify the routing of existing circuits. Maintain circuit continuity between existing fixtures which remain.

L. In areas which are remodeled, replace existing wire with new wire. No existing wire is permitted to remain unless noted.

M. Existing concealed conduit and boxes may be reused.

N. Verify existing conditions in field prior to bid date.

3.12 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations.

B. Perform cutting by skilled mechanics of trades involved.

C. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

D. Install new fireproofing where existing firestopping has been disturbed.

E. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.13 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work. Repair as necessary.

3.14 CLEANING AND PROTECTION

A. Remove burrs, dirt, paint spots, and construction debris from electrical items.

B. Protect electrical items so that finishes are without damage or deterioration at time of Substantial Completion.

C. All cables and wiring shall be protected from paint. This includes but is not limited to power conductors and feeders, lighting control wiring, and fire alarm cabling. Painted cables shall be replaced in their entirety.

3.15 TEMPORARY POWER AND LIGHTING

A. Provide temporary power and lighting throughout the construction period for the use by all trades, Contractors and Sub-Contractors.

B. Temporary facilities shall be installed in compliance with applicable codes and in compliance with OSHA requirements.

C. Where existing building electrical system is used to provide temporary power and lighting, energy costs shall be paid by the Owner.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Electrical tape.

C. Heat shrink tubing.

D. Wire pulling lubricant.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.03 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

1.06 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.

H. Minimum Conductor Size:
   1. Branch Circuits: 12 AWG.
   2. Control Circuits: 14 AWG.

I. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
    a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
    a. 480Y/277 V, 3 Phase, 4 Wire System:
        1) Phase A: Brown.
        2) Phase B: Orange.
        3) Phase C: Yellow.
        4) Neutral/Grounded: Gray.
    b. 208Y/120 V, 3 Phase, 4 Wire System:
        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
        4) Neutral/Grounded: White.
    c. Equipment Ground, All Systems: Green.
    d. For control circuits, comply with manufacturer's recommended color code.

1.07 SINGLE CONDUCTOR BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor Stranding:
1. Feeders and Branch Circuits:
    a. Size 10 AWG and Smaller: Solid or Stranded.
    b. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:
1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2, except as indicated below.
    a. Installed Underground: Type XHHW-2 or THHN/THWN-2.

E. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

F. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

G. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

H. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

I. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

J. Mechanical Connectors: Provide bolted type or set-screw type.

K. Compression Connectors: Provide circumferential type or hex type crimp configuration.

1.08 ACCESSORIES

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

2.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

2.03 INSTALLATION

A. Circuiting Requirements:
1. When circuit destination is indicated without specific routing, determine exact routing required.
2. Install service and feeder conductors unspliced unless otherwise indicated.
3. Arrange branch circuiting to minimize splices.
4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
   a. Provide no more than 6 #12 AWG current-carrying conductors in 1/2 inch conduit; 9 #12 AWG current-carrying conductors in 3/4 inch conduit.
   b. Provide no more than 6 #10 AWG current-carrying conductors in 3/4 inch conduit; 9 #10 AWG current-carrying conductors in 1 inch conduit.
   c. Provide no more than 4 #8 AWG current-carrying conductors in 3/4 inch conduit; 6 #8 AWG current-carrying conductors in 1 inch conduit; 9 #8 AWG current-carrying conductors in 1-1/4 inch conduit.
7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:
1. Pull all conductors and cables together into raceway at same time.
2. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

3. Use suitable wire pulling lubricant where necessary, except as below:
    a. Do not use when lubricant is not recommended by the conductor manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Install conductors with a minimum of 6 inches of slack at each outlet.

G. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

H. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

I. Make wiring connections using specified wiring connectors.
    1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies.
    2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
    3. Do not remove conductor strands to facilitate insertion into connector.
    4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
    5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
    6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

J. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
    1. Dry Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
    2. Damp Locations: Use insulating covers specifically designed for the connectors or heat shrink tubing.
        a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
    3. Wet Locations: Use heat shrink tubing.

K. Insulate ends of spare conductors using vinyl insulating electrical tape.

L. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

M. Identify conductors and cables in accordance with Section 26 0553.

N. Install firestopping to preserve fire resistance rating of partitions and other elements.

O. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

SECTION 26 0526
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NFPA 70 - National Electrical Code.

C. UL 467 - Grounding and Bonding Equipment.

D. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 DEFINITIONS

A. ACEG: Alternating Current Equipment Ground

B. BCT: Bonding Conductor for Telecommunications (formerly Telecommunications Bonding Conductor)

C. BBC: Backbone Bonding Conductor (formerly Grounding Equalizer)

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Comply with TIA/EIA-607 for telecommunications grounding.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    a. Provide continuous grounding electrode conductors without splice or joint.
    b. Install grounding electrode conductors in raceway. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

E. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical

conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
   1. Use insulated copper conductors unless otherwise indicated.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections, high-pressure compression conections, or high-pressure compression conections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use compression connectors for accessible connections. For #6 AWG and smaller, use one-hole lugs. For #4 AWG and larger, use two-hole lugs.
      a. Exceptions:
         1) Use exothermic welded connections or high-pressure compression connections for connections to metal building frame.
   4. Manufacturers - High-Pressure Compression Connectors:
      a. Burndy: www.burndy.com; Hyground System
      b. Thomas & Betts: www.tnb.com.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install each bonding conductor in a direct route, and parallel or perpendicular to building structure or surfaces, without interfering with other systems or equipment.

D. Install exterior grounding electrode conductors with a minimum bending radius of 12 inches.

E. Install interior grounding conductors with a minimum bending radius of 8 inches.

F. Install grounding conductors in EMT conduit unless otherwise indicated. Bond each end of the conduit to the grounding conductor using an appropriate grounding bushing.

G. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

H. Identify grounding and bonding system components in accordance with Section 26 0553.
1. Clean each surface prior to attachment of label.
2. Follow manufacturer's recommendations for affixing labels.

3.03 FIELD QUALITY CONTROL

A. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

B. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

SECTION 26 0529
HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
   2. Coordinate work to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
   4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
   5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.05 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.
   2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
   3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
    1. Conduit Straps: One-hole or two-hole type; steel.
    2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:
    1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
    2. Comply with MFMA-4.
    3. Channel Material:
        a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
        b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:
    1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
    2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
    3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
    4. Hollow Masonry: Use toggle bolts, expansion anchors, or expansion anchors.
    5. Hollow Stud Walls: Use toggle bolts.
    6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
    7. Sheet Metal: Use sheet metal screws.
    8. Wood: Use wood screws.
    9. Plastic and lead anchors are not permitted.
    10. Powder-actuated fasteners are not permitted.

G. Cable Supports for Vertical Conduit: Factory-fabricated body with insulated wedging plug, appropriately sized for conductors being supported.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

2.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3-1/2 inch high concrete pad.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
6. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. Secure fasteners in accordance with manufacturer's recommended torque settings.

I. Remove temporary supports.

J. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

SECTION 26 0533.13
CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Galvanized steel intermediate metal conduit (IMC).
C. Flexible metal conduit (FMC).
D. Liquidtight flexible metal conduit (LFMC).
E. Galvanized steel electrical metallic tubing (EMT).
F. Rigid polyvinyl chloride (PVC) conduit.
G. Accessories.

1.02 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).
C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
J. NFPA 70 - National Electrical Code.
K. UL 1 - Flexible Metal Conduit.
L. UL 6 - Electrical Rigid Metal Conduit-Steel.
M. UL 360 - Liquid-Tight Flexible Metal Conduit.
N. UL 514B - Conduit, Tubing, and Cable Fittings.
O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
P. UL 797 - Electrical Metallic Tubing-Steel.
Q. UL 1242 - Electrical Intermediate Metal Conduit-Steel.
R. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
    2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
    3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
    4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
    5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.04 QUALITY ASSURANCE

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Outdoor Underground Installations:
   1. Unless otherwise indicated, use rigid non-metallic conduit

C. Outdoor Locations Above Grade: Use rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.

D. In Slab Above Grade or Beneath Slab-on-Grade:
   1. Use rigid non-metallic conduit.

E. Dry Locations:
   1. Concealed: Use electrical metallic tubing.
   2. Exposed: Use electrical metallic tubing.

F. Connection to Motors: Use liquid-tight flexible metal conduit, except use flexible metal conduit in air plenums.

G. Connection to Vibrating Equipment (including transformers):
   1. Indoors: Use flexible metal conduit.
   2. Outdoors: Use liquid-tight flexible metal conduit.

2.02 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Provide conduit, fittings, supports, and accessories required for complete raceway system.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4-inch trade size.
   2. Telecommunications Pathways: 1 inch trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:
   1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
   2. Material: Use steel.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
2. Material: Use steel.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.05 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360; rated for use with conductors rated 75 degrees C.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:
1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel.
3. Connectors and Couplings: Use compression/gland or set-screw type.
a. Do not use indenter type connectors and couplings.
4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

B. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 200 lbf.

D. Foam Conduit Sealant:
1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.

2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
3. Rated to hold minimum of 10 ft water head pressure.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

F. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated without specific routing, determine exact routing required.
   3. Conceal conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
   5. Unless otherwise approved, do not route exposed conduits:
      a. Across floors.
      b. Across roofs.
      c. Across top of parapet walls.
      d. Across building exterior surfaces.
   6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
   7. Arrange conduit to maintain adequate headroom, clearances, and access.
   8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
   9. Exterior Branch Circuits: Route conduits adjacent to curbs. Push or directional bore conduits beneath paved areas; otherwise, sawcut and remove pavement. Replace removed pavement to match existing.
   10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   11. Maintain minimum clearance of 12 inches between conduits and hot surfaces.
   12. Group parallel conduits in same area on common rack.

G. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
      a. Support PVC conduit within 3 feet of termination points and at intervals not exceeding those listed below in accordance with NFPA 70 Table 352.30.
         1) 1/2" to 1" trade size = 3 feet spacing between supports.
         2) 1-1/4" to 2" trade size = 5 feet spacing between supports.
         3) 2-1/2" to 3" trade size = 6 feet spacing between supports.
         4) 3-1/2" to 5" trade size = 7 feet spacing between supports.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use of spring steel conduit clips for support of conduits is permitted only as follows:
   a. Support of electrical metallic tubing (EMT)1-1/2 inch trade size concealed above accessible ceilings and within hollow stud walls.
5. Use of wire for support of conduits is permitted only as follows:
   a. For suspending conduits supported by spring steel conduit clips, where specifically indicated or permitted.

H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
5. Provide insulated bushings on box connectors 1-inch and larger, on conduits stubbed above an accessible ceiling, and on conduits used for telecommunications pathways.
6. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
4. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
5. Install firestopping to preserve fire resistance rating of partitions and other elements.

J. Conduits Beneath Slab on Grade:
1. Transition to rigid steel conduit, intermediate metal conduit, or electrical metallic tubing where conduit exits slab, except where concealed in walls rigid nonmetallic conduit may be stubbed a maximum of 14 inches above floor level.

K. Conduits Embedded in Concrete Slabs:
1. Install with at least 2 inches of concrete cover.
2. Space a minimum of three diameters on center.
3. Transition to rigid steel conduit, intermediate metal conduit, or electrical metallic tubing where conduit exits slab, except where concealed in walls rigid nonmetallic conduit may be stubbed a maximum of 14 inches above floor level.
4. Do not place raceways in plain concrete, such as cement toppings on structural floors, without special permission. Do not displace reinforcing steel to accommodate raceway installation in reinforced concrete. Particular attention is called to the fact that there are many extenuating conditions where the Contractor may be instructed, during the course of the project, not to place embedded conduits in certain areas, generally due to the possibility of unsightly cracking or for structural reasons. Being so instructed shall not entitle the Contractor to extra compensation. Obtain permission from the Engineer for any raceway installation in reinforced concrete which requires concrete displacement exceeding the following:
   a. Columns: 4 percent of plan area of column.
   b. Floors : 1/3 of thickness of concrete.

c. Beams and Joists: 1/3 of least dimension.

L. Telecommunications Raceways: Install raceways in maximum lengths of 100 feet and with a maximum of two 90-degree bends or equivalent between boxes or pull points. Separate lengths with pull or junction boxes where necessary to comply with these requirements. Locate junction boxes in straight conduit runs. Do not install junction boxes where conduit runs change direction. Keep telecommunications raceways at least 5 inches away from light fixtures, transformers, panelboards, and feeders. Keep non-metallic telecommunications raceways at least 24 inches away from electrical equipment, feeders, and services.

M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where change in length, calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground, is expected to be 1/4 inch or greater between securely mounted items such as boxes, cabinets, elbows, or other conduit terminations, which includes the following conditions:
      a. 100 foot intervals within spaces that have an ambient temperature range of 0-5 degrees Fahrenheit or less.
      b. 60 foot intervals within spaces that have an ambient temperature range of 5-10 degrees Fahrenheit or less.
      c. 40 foot intervals within spaces that have an ambient temperature range of 10-15 degrees Fahrenheit or less.
   3. Where conduits are subject to earth movement by settlement or frost.

N. Conduit Sealing:
   1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
      a. Where conduits enter building from outside.
      b. Where service conduits enter building from underground distribution system.
      c. Where conduits enter building from underground.
      d. Where conduits may transport moisture to contact live parts.
   2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant, junction box, or type C condulet at accessible point near penetration to prevent condensation. This includes, but is not limited to:
      a. Where conduits pass from outdoors into conditioned interior spaces.
      b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

O. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

P. Provide grounding and bonding; see Section 26 0526.

Q. Identify conduits; see Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

A. Immediately after installation of conduit, use suitable caps to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.16
BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 REFERENCE STANDARDS

A. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

C. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

D. NFPA 70 - National Electrical Code.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

G. UL 508A - Industrial Control Panels.

H. UL 514A - Metallic Outlet Boxes.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

C. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Do not use "through-wall" boxes designed for access from both sides of wall.
   7. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   8. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   9. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   10. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   11. Minimum Box Size, Unless Otherwise Indicated:
      a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
      b. Communications Systems Outlets: 4 inch square by 2-1/8 inch deep trade size.
      c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
   12. Wall Plates: Comply with Section .

D. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
      a. Indoor Clean, Dry Locations: Type 1, painted steel.
      b. Outdoor Locations: Type 3R, painted steel.
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
      b. Include cable supports if any dimension of the box is greater than 48 inches.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify locations of floor boxes prior to rough-in.

2.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:
   1. Locate boxes to be accessible. Provide access panels as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
   10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
   11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in unfinished areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

H. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
   4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

R. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

S. Orient each box located above an accessible ceiling so the box opening faces down or to one side.

T. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

U. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

V. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

2.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

2.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Identification for conductors.

D. Underground warning tape.

E. Warning signs and labels.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.

C. NFPA 70 - National Electrical Code.

D. NFPA 70E - Standard for Electrical Safety in the Workplace.

1.03 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify electrical equipment.
      a. Panelboards:
         1) Identify panelboard name.
         2) Identify power source and circuit number. Include location when not within sight of equipment.
         3) Use typewritten circuit directory to identify load(s) served for panelboards with a door.
         4) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device.
      b. Enclosed switches:
         1) Identify power source and circuit number. Include location when not within sight of equipment.
         2) Identify load(s) served.
   2. Available Fault Current Documentation: Use identification nameplate to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   3. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
      a. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or

branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Raceways:
   1. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:
   1. Use handwritten text using indelible marker to identify circuits enclosed.
      a. For exposed boxes in public areas, provide identification on inside face of cover.

E. Identification for Devices:
   1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
   2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
      a. Color: White text on black background.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com/#sle.
      b. Brother International Corporation: www.brother-usa.com/#sle.
      c. Panduit Corp: www.panduit.com/#sle.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
   4. Color: Black text on clear background. Provide black text on white background when applying to a dark surface.

C. Format for Equipment Identification:
   1. Minimum Size:
      a. Plastic Nameplates: 1 inch by 2.5 inches.
      b. Identification Labels: 0.5 inch by 2.5 inches.
   2. Minimum Size: 1 inch by 2.5 inches.
   3. Legend:
      a. Equipment designation or other approved description.
   4. Text: All capitalized unless otherwise indicated.
   5. Minimum Text Height:
      a. Equipment Designation: 3/8 inch.

2.03 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.04 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: inside of equipment door when installed in a finished location.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Boxes: Outside face of cover.
   6. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws or self-adhesive backing and to interior surfaces using self-adhesive backing.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 6 inches below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 0583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 REFERENCE STANDARDS

A. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

B. NFPA 70 - National Electrical Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

1. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
2. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

C. Provide receptacle outlet to accommodate connection with attachment plug.

D. Provide cord and cap where field-supplied attachment plug is required.

E. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

F. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

G. Provide final power and control connections for equipment furnished under other Divisions of this specification and for Owner-furnished equipment. Where not specified in mechanical sections of this specification, connect motor controls and associated mechanical equipment as required for a complete and functional control system.

H. Provide interlocks and wiring to and between controls for Owner-furnished equipment, condensing units and fan coil units.

I. Verify control wiring requirements with manufacturer certified shop drawings for each piece of equipment or control system and install accordingly. Install control wiring in conduit.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall pushbutton stations.

B. Occupancy sensors.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NFPA 70 - National Electrical Code.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
   2. Coordinate placement of wall switch occupancy sensors with installed door swings.
   3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
   4. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 5100 and lighting fixture schedule.
   5. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

C. Pre-Wire Meeting:
   1. Include the services of a factory trained technician to attend and facilitate an on-site pre-wire meeting to review system installation requirements.
   2. Schedule meeting to occur after receipt of final shop drawings.

1.04 SUBMITTALS

A. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features of products being provided.

B. Shop Drawings:
   1. Provide lighting plan, drawn to scale, indicating location, model number, and orientation of each device being provided.
   2. Pushbutton Stations: Provide elevation of each unique pushbutton station indicating button labeling.
   3. Interconnection diagram of field installed wiring.

C. Functional Performance Testing Reports.

D. Operation and Maintenance Data: Submit within 90 days of receipt of the Certificate of Occupancy. Include the following:
   1. Name and address of not less than one service agency for installed equipment.
   2. Narrative of how each system is intended to operate, including recommended setpoints.
   3. Submittal data indicating all selected options for each piece of lighting control equipment and lighting controls.
   4. Manual for each piece of lighting control equipment indicating required routine maintenance actions and cleaning.
   5. Schedule for inspecting and recalibrating lighting controls.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Occupancy Sensors, Power Packs, Room Controllers, and Wall Pushbutton Stations (without labeling): Two percent of total quantity installed for each type, but not less than one of each type.

F. Project Record Documents: Submit within 90 days of receipt of the Certificate of Occupancy. Record actual installed location, catalog number, and settings for each lighting control device.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

C. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A. Provide five year manufacturer warranty for lighting control components.

1.09 MANUFACTURERS

A. Acuity Brands.

B. Encelium.

C. Lutron.

D. Wattstopper.

E. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier, where possible, unless indicated otherwise.

F. Substitutions and Prior Approval Requests: Manufacturers not listed will be considered as a prior approval or substitution request. Provide the following:
1. Manufacturer's cut sheets for proposed components.
2. Example wiring schematic.
3. Upon request, a working sample.

1.10 LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. System Description: Distributed, low voltage, digital load controllers that control lighting within rooms/spaces. Link load controllers as part of a networked lighting control system as indicated on the Lighting Control Schedule.

B. Provide system consisting of wired components.

C. Provide products listed, classified, and labeled as suitable for purpose intended.

D. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system compatible with controlled luminaires.

E. Provide controller as required to support time of day and astronomical time clock capabilities for scheduled lighting control events.

F. Provide factory pre-terminated and tested plenum rated cables for interconnection of system components, types as recommended by manufacturer.
1. Select cable lengths based on actual installation conditions.

2. Cables shall be as short as practical.
3. Provide white cables unless noted otherwise.

G. Where dimming is indicated, provide a continuous flicker-free dimming system.

H. Where networked lighting control system is indicated, provide:
1. Web-based user interface.

1.11 WALL PUSHBUTTON STATIONS

A. General Requirements: Low voltage, quiet operating, types as indicated on drawings, compatible with load types being controlled. Provide factory labeled pushbuttons.

B. Where dimming controls are indicated, provide separate raise and lower buttons.

C. Provide devices and plates with finishes matching wiring devices.

1.12 OCCUPANCY SENSORS

A. General Requirements:
1. Provide the following type of sensor per area, unless indicated otherwise:
a. Offices: Dual technology.
b. Classrooms: Dual technology.
c. Restrooms: Ultrasonic or microphonic.
d. Corridors: Passive infrared.
e. Other Areas: As recommended by manufacturer.
2. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
3. Provide LED to visually indicate motion detection.
4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.
5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
8. Sensitivity: Field adjustable.
9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
10. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.
11. Isolated Relay for Low Voltage Occupancy Sensors: Where indicated, SPDT dry contacts, ratings as required for interface with system indicated.

B. Wall Switch Occupancy Sensors:
1. General Requirements:
a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
b. Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.
c. Where indicated or required, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.

d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
e. Where dimming is indicated or required, comply with the following:
1) Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
2) Provide field adjustable dimming preset for occupied state.
3) Provide fade-to-off operation to notify occupant of impending load turn-off.

2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.
3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within area of 400 square feet.
4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet.

C. Ceiling Mounted Occupancy Sensors:
1. General Requirements:
a. Description: Low profile occupancy sensors designed for ceiling installation.
b. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
c. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within area of 500 square feet at mounting height of 9 feet, with field of view of 360 degrees.
b. Medium Range Sensors: Capable of detecting motion within area of 1,000 square feet at mounting height of 9 feet, with field of view of 360 degrees.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.

D. Directional Occupancy Sensors:
1. General Requirements:
a. Description: Occupancy sensors designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
2. Passive Infrared (PIR) Directional Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within distance of 40 feet at mounting height of 10 feet.
b. Long Range Sensors: Capable of detecting motion within distance of 80 feet at mounting height of 10 feet.
3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within distance of 40 feet at mounting height of 10 feet.

E. Power Packs for Occupancy Sensors:
1. Description: Plenum rated, self-contained class 2 transformer and relay compatible with specified occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
3. Load Rating: As required to control load indicated on drawings.
4. Provide auxiliary contact closure output where indicated.

5. Rated Life of Relay: One million cycles.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

2.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

2.03 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 0533.16.
   1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate; see Section 26 2726.

G. Provide required supports; see Section 26 0529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices; see Section 26 0553.

J. Occupancy Sensor Locations:
   1. Drawings are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

3. Locate sensors so that coverage does not extend beyond the area controlled.
4. Drawings are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.

K. Unless otherwise indicated, install emergency lighting relays and power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

L. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

M. Unless otherwise indicated, install low voltage control cabling in conduit in areas with exposed structure and above inaccessible ceilings.

N. Low voltage control cabling may be installed without conduit where concealed above an accessible ceiling. For wall-mounted devices, provide conduit stubbed to above the nearest accessible ceiling. Route cabling parallel or perpendicular to building structure or surfaces.
1. Support using J-hook cable hangers or plenum rated cable ties attached to conduit supports or to branch circuit conduits as allowed by Code. Locate supports with a maximum spacing of 10 feet.
2. Do not support from piping, ductwork or other systems. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
3. Coil and support excess cable slack.

O. Maintain separation of normal and emergency branch circuit wiring connected to emergency lighting relays as required by NFPA 70. Normal and emergency branch circuits can be combined only within the emergency lighting relay enclosure.

P. Fire Alarm System Integration: Program emergency lighting relay(s) to drive emergency lighting to full brightness upon signal from fire alarm system under general fire alarm.

2.04 SYSTEM STARTUP AND PROGRAMMING

A. Coordinate system programming and device engraving with Owner.

B. Provide factory startup and programming of system. Program according to Owner's requirements.

C. Coordinate high end and/or low end trim levels with Owner and Architect during system programming.

2.05 FIELD QUALITY CONTROL

A. Inspect each lighting control device for damage and defects.

B. Perform functional performance tests as required by this specification section and as required by applicable codes.

C. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

2.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

2.07 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

2.08 FUNCTIONAL PERFORMANCE TESTING

A. Prior to final inspection, perform functional performance testing and submit documentation to the Architect that control hardware and software are calibrated, adjusted, programmed and in

proper working condition in accordance with the construction documents and manufacturer's instructions.

1. Occupancy sensor controls.
    a. Certify that each occupancy sensor has been located and aimed in accordance with manufacturer recommendations
    b. Test each occupancy sensor.
    c. Verify the following:
        1) Where included, status indicators operate correctly.
        2) The controlled lights turn off or down to the permitted level within the required time.
        3) For auto-on occupancy sensor controls, the lights turn on to the permitted level when an occupant enters the space.
        4) For manual-on occupancy sensor controls, the lights turn on only when manually activated.
        5) The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.
2. Provide a report of the test results. Include the following:
    a. Results of functional performance tests.
    b. Disposition of deficiencies found during testing, including details of corrective measures used or proposed.

2.09 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
    1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
    2. Provide minimum of two hours of training.
    3. Instructor: Manufacturer's authorized service representative.
    4. Location: At project site.

2.10 MAINTENANCE

A. Occupancy Adjustments: Within one year of Substantial Completion, provide on-site assistance by a manufacturer's authorized service representative to make system adjustments or to provide training. Provide three visits, at approximately three, six and twelve months after Substantial Completion for this purpose.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 407 - Standard for Installing and Maintaining Panelboards.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 67 - Panelboards.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

K. UL 869A - Reference Standard for Service Equipment.

L. UL 943 - Ground-Fault Circuit-Interrupters.

M. UL 1699 - Arc-Fault Circuit-Interrupters.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

D. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Panelboard Keys: six of each different key.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier, where possible.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
      b. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating as indicated on the drawings. Where the available fault current is indicated, provide panelboards with listed short circuit current rating not less than the available fault current.
   2. Listed series ratings are acceptable only where specifically indicated.
   3. Label equipment utilizing series ratings as required by NFPA 70.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation. Do not reduce panelboard pole quantity or mounting spaces indicated on drawings by installation of branch-mounted main device, where used. Provide additional poles or spaces as required.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1.
2. Boxes: Galvanized steel unless otherwise indicated.
a. Provide wiring gutters sized to accommodate the conductors to be installed.
3. Fronts:
a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum or copper.
3. Ground Bus Material: Aluminum or copper.

D. Circuit Breakers: Thermal magnetic bolt-on type.

E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.
4. Minimum dimensions: 5-1/2 inches deep, 20 inches wide.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    2) 14,000 rms symmetrical amperes at 480 VAC.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Conductor Terminations:
    a. Provide mechanical lugs unless otherwise indicated.
    b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
    a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
    a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
    b. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
7. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
8. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
9. Do not use tandem circuit breakers.
10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
11. Provide the following features and accessories where indicated or where required to complete installation:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad.

J. Provide minimum of six spare 3/4 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space below floor.

K. Provide grounding and bonding in accordance with Section 26 0526.

L. Install all field-installed branch devices, components, and accessories.

M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in panelboards.

P. Identify panelboards in accordance with Section 26 0553.

Q. If the overcurrent protection for a panelboard feeder is less than the nameplate rating of the panelboard, provide a plastic nameplate indicating the ampacity of the feeder circuit. Attach nameplate to the inside of the panelboard so it is visible when the panelboard door is opened.

R. Connections:
   1. Connect phase conductors A, B, C left to right as viewed from the front of the panel unless bus bars are factory labeled otherwise.
   2. Connect each branch circuit served by a lighting and appliance branch circuit panelboard to a 20A 1-pole breaker unless otherwise indicated.
   3. Circuit numbering indicated for lighting and appliance branch circuit panelboards is based on pole position within the panelboard. For multipole breakers, the circuit number corresponds to the first pole position occupied by the breaker.
   4. Circuit number indicated for distribution panelboards is based on consecutive numbering.

3.03 FIELD QUALITY CONTROL

A. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

B. Test GFCI circuit breakers to verify proper operation.

C. Test AFCI circuit breakers to verify proper operation.

D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Device plates and box covers.

1.02 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices.

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

C. NFPA 70 - National Electrical Code.

D. UL 20 - General-Use Snap Switches.

E. UL 498 - Attachment Plugs and Receptacles.

F. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

2.02 MANUFACTURERS

A. Cooper Wiring Devices: www.cooperwiringdevices.com.

B. Hubbell Incorporated: www.hubbell-wiring.com.

C. Leviton Manufacturing Company, Inc: www.leviton.com.

D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

E. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.03 WIRING DEVICE FINISHES

A. Device Color: White unless otherwise indicated or required by code; brown in dark brick, wood paneled or dark-finished walls.

2.04 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

B. Acceptable products are listed below for specific device types.

C. Standard Switches: 20A, 120/277 V AC

Description	Cooper	Hubbell	Leviton	P & S
Single pole	CSB120	CSB120	CS120-2	CSB20AC1
Double pole	CSB220	CSB220	CS220-2	CSB20AC2
Three-way	CSB320	CSB320	CS320-2	CSB20AC3
Four-way	CSB420	CSB420	CS420-2	CSB20AC4

D. Keyed Switches: 20A, 120/277 V AC

Description	Cooper	Hubbell	Leviton	P & S
Single Pole	AH1221L	HBL1221L	1221-2L	PS20AC1L
Double Pole	AH1222L	HBL1222L	1222-2L	PS20AC2L
Three-way	AH1223L	HBL1223L	1223-2L	PS20AC3L
Four-way	AH1224L	HBL1224L	1224-2L	PS20AC4L

E. Special Switches

Description	Cooper	Hubbell	Leviton	P & S
Single pole with pilot light	AH1201PL	HBL1221PL	1221-PLR	PS20AC1RPL
Single pole momentary contact	1995	HBL1557	1257	1251
Single pole lighted toggle	AH1221LT	HB1221IL	1221-LH	PS20AC1ISL
Combination switch/receptacle	TR291	RR108	5335	671
Door switch	-	RDS50	1865	-

2.05 RECEPTACLES

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. Acceptable products are listed below for specific device types.

C. Straight Blade Receptacles: 20A, 125V.

Description	Cooper	Hubbell	Leviton	P & S
Simplex	1877	HBL5361	5891	5361

Duplex	BR20	BR20	5362	CRB5362
Duplex tamper resistant	TRBR20	BR20TR	T5362	TR5362
Duplex GFCI	SGF20	GFRST20	GFNT2	2097
Duplex GFCI tamper resistant	TRSGF20	GFTRST20	GFTR2	2097TR
Duplex GFCI weather resistant	WRSGF20	GFRWR20	GFWT2	2097TRWR
Duplex GFCI weather resistant, tamper resistant	WRSGF20	GFRTW20	GFWR2	2097TRWR
Duplex isolated ground	IG5362	IG20CR	5362-IG	IG5362
Duplex tamper resistant with USB-A and USB-C charging ports	TRUSBAC20	USB20AC5	T5833	TR20USBAC6
Duplex TVSS	5362S	HBL5362SA	7380	5362SP
Clock hanger	775V	RR151CHI	688	S3713

2.06 WALL PLATES AND COVERS

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Screws: Metal with slotted heads finished to match wall plate finish.

B. Wall Plates for Flush Devices: Type 302 or 304, satin finished stainless steel, minimum thickness 0.03 inches.

C. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
   1. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
   2. Where multiple devices are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   3. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

B. Install wiring devices in accordance with manufacturer's instructions.

C. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

D. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

E. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices unless otherwise indicated.

G. Install wiring devices plumb and level with mounting yoke held rigidly in place.

H. Install wall switches with OFF position down.

I. Install vertically mounted receptacles with grounding pole on bottom.

J. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

K. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas and above accessible ceilings.

3.04 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

D. NFPA 70 - National Electrical Code.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

G. UL 98 - Enclosed and Dead-Front Switches.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Project Record Documents: Record actual locations of enclosed switches.

C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.electrification.us.abb.com.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier, where possible.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Provide with switch blade contact position that is visible when the cover is open.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

J. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

L. Heavy Duty Switches:
   1. Comply with NEMA BS 31047.
   2. Conductor Terminations:
      a. Provide mechanical lugs unless otherwise indicated.
      b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 60 inches above the floor or working platform.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Identify enclosed switches in accordance with Section 26 0553.

J. Bolt closed exterior grade level enclosures.

3.03 FIELD QUALITY CONTROL

A. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Luminaires mounted on exterior of building.

C. Drivers

1.02 REFERENCE STANDARDS

A. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.

F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.

G. NFPA 70 - National Electrical Code.

H. NFPA 101 - Life Safety Code.

I. UL 924 - Emergency Lighting and Power Equipment.

J. UL 1598 - Luminaires.

K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.04 SUBMITTALS

A. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide dimensioned drawing for each custom length luminaire.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

b. Include IES LM-79 test report upon request.
c. Include color temperature, CRI, luminaire input wattage and delivered lumen output.
d. Include color information based on IES TM-30 test upon request.

2. Drivers: Include product data, dimming protocol, voltage and environmental rating.

C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Drivers: Two percent of total quantity installed for each type, but not less than one of each type.

E. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

C. Luminaires for the project shall be submitted through an electrical distributor within 250 miles of the project site. Deviations from this requirement must be submitted for prior approval.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A. Provide minimum five year manufacturer warranty for all LED luminaires, including drivers.

B. Provide minimum five year pro-rata warranty for batteries for emergency lighting units.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in schedule included on the drawings.

B. Substitutions (for cost reduction after bid) and Prior Approval Requests (prior to bid): Luminaires not specified or listed as an alternate in the Luminaire Schedule will be considered as a prior approval or substitution request. Provide and identify the following information with the manufacturer's cut sheet:
1. Estimated useful life, calculated based on IES LM-80 test data.
2. Delivered lumen output, calculated based on IES LM-79.
3. Color temperature, CRI, luminaire input wattage and warranty.
4. Color information, based on IES TM-30 test report.
5. Upon request, IES LM-79 report, LM-80 report, and TM-30 report.
6. Upon request, photometric calculation comparison to the basis of design luminaire for the applicable project space/area.
7. Upon request, a working sample with 120 Volt cord and plug.
8. Deviations from the specified luminaire.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70 and NFPA 101.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Unless otherwise indicated, for each type of lamp/luminaire, provide products which are consistent in perceived color temperature. Replace lamps/luminaires that are determined by the Architect to be inconsistent in perceived color temperature.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Unless otherwise indicated, provide luminaires including lamp(s) and all sockets, ballasts/drivers, reflectors, lenses, housings, wiring and other appurtenances required for a complete and operational system.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operational system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

H. For continuous wall-to-wall luminaires, field verify exact wall-to-wall dimensions prior to ordering.

I. Sheet Metal Components: Steel, unless otherwise indicated, without sharp corners or edges.

J. Doors and Frames: Free of light leaks.

K. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single- or double-face as indicated or as required for installed location.
   2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
   1. Self-Powered Exit Signs:
      a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
      b. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
      c. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.04 DRIVERS

A. Drivers - General Requirements:
   1. Provide drivers containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide drivers complying with all current applicable federal and state driver efficiency/efficacy standards.
   3. Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to ten percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.05 ACCESSORIES

A. Provide accessories and fittings as recommended by the manufacturer to properly and completely install and wire luminaires.

B. Provide accessory plaster framesas required, designed and finished to preclude the possibility of rust stains on surrounding surfaces.

C. Fixture Whips: Flexible whips including phase, neutral and grounding conductors, #18 AWG minimum; minimum length, 4 feet; maximum length, 6 feet, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Verify ceiling and wall details from general construction documents prior to ordering luminaires. Provide proper mounting accessories for the intended installation. Install fixture trim tight to surrounding surfaces. Secure to prevent movement.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install products in accordance with manufacturer's instructions.

E. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

F. Provide required support and attachment in accordance with Section 26 0529.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Support luminaires from grid. Provide additional supports or support clips as required.
   3. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   4. Luminaires smaller than grid openings: Center in acoustical panels unless otherwise indicated on reflected ceiling plan. Provide supporting members as required.
   5. Secure surface-mounted luminaires to building structure.
   6. Secure pendant-mounted luminaires to building structure.

I. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.

J. Suspended Luminaires:
   1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
   2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   3. Install canopies tight to mounting surface.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

L. Surface Mounted Luminaires:
   1. Mount tight to surrounding surfaces.
   2. Locate outlet boxes in finished areas so they are concealed by luminaires.

M. Install accessories furnished with each luminaire.

N. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture.

O. Fixture Whips:
   1. Use for recessed luminaires installed in an accessible ceiling.
   2. Anchor according to code.
   3. Install between each fixture and a junction box located above the ceiling. Wire from fixture to fixture only for tandem ballast installations.

P. Bond products and metal accessories to branch circuit equipment grounding conductor.

Q. Dimmable Luminaires: Provide required control wiring, as recommended by the manufacturer, between each luminaire and its associated control device.

R. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

S. Remote Ballasts and Drivers: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.

3.04 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

A. Just prior to Substantial Completion, review proper operation of luminaires and correct deficiencies or make adjustments as required. Replace failed components as required.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 32 1313

CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pavement

B. Curb and Gutter

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of full depth PCC pavement and curb and gutter.

1.03 SUBMITTALS

Comply with General Provisions, as well as the following:

A. Two weeks prior to commencing any PCC pavement placement, submit a paving mix design for each different source of aggregate to be used for review and approval by the Engineer. Submit mixes or mix designs approved by the Iowa Department of Transportation or an independent testing laboratory.

B. Maturity curves for paving mixes and maturity reading results.

C. Submit all testing and certifications according to Section 32 13 13, 3.07.

1.04 SUBSTITUTIONS

Comply with General Provisions.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with General Provisions, as well as the following:

A. Aggregate Storage: Comply with Iowa DOT Article 2301.02, C.

B. Cement and Fly Ash: Comply with Iowa DOT Article 2301.02, C.

C. Admixtures: Store in suitable weather tight enclosures which will preserve quality.

D. Reinforcing Steel: Store off ground on timbers or other supports.

1.06 SCHEDULING AND CONFLICTS

Comply with General Provisions, as well as the following:

Complete elements of the work that can affect line and grade in advance of other open cut construction unless noted on plans.

1.07 SPECIAL REQUIREMENTS

None

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Meet the requirements of Iowa DOT Section 4101 and Materials I.M. 401,

including Type I and Type II cements and blended hydraulic cements Type 1P, Type 1S, Type 1T, and Type 1L.

B. Supplementary Cementitious Materials (SCM):

1. **Fly Ash:** Comply with Iowa DOT Section 4108.

2. **Ground Granulated Blast Furnace Slag (GGBFS):** Comply with Iowa DOT Section 4108.

3. **Limestone:** Comply with Iowa DOT Materials I.M. 401.

C. Fine Aggregate for Concrete:

1. Meet the requirements of Iowa DOT Section 4110 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with the following gradation:

Sieve Size	Percent Passing
3/8”	100
No. 4	90 to 100
No. 8	70 to 100
No. 30	10 to 60
No. 200	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 1 in the Aggregate Gradation Table.	

3. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with Iowa DOT Section 4115 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with one of the following gradations:

Sieve Size	Gradation No. 3 Percent Passing	Gradation No. 4 Percent Passing	Gradation No. 5 Percent Passing
1 1/2”	100	100	-----
1”	95 to 100	50 to 100	100
3/4”	-----	30 to 100	90 to 100
1/2”	25 to 60	20 to 75	-----
3/8”	-----	5 to 55	20 to 55
No. 4	0 to 10	0 to 10	0 to 10
No. 8	0 to 5	0 to 5	0 to 5
No. 200	0 to 1.5	0 to 1.5	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 3, 4, and 5 in the Aggregate Gradation Table.			

3. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

E. Intermediate Aggregate for Concrete: Use if specified in contract documents.

1. Meet the requirements of Iowa DOT Section 4112 and Materials I.M. 409, Source Approvals for Aggregates.

2. For crushed limestone or dolomite, meet the durability class required for the coarse aggregate. When gravel durability is lower than the coarse aggregate durability requirements, pea gravel is not to exceed 15% of the total aggregate mix.

3. Comply with the following aggregate gradation:

Sieve Size	Percent Passing
1/2”	95 to 100
3/8”	-----
No. 4	-----
No. 8	0 to 10
Iowa DOT Article 4109.02, Gradation No. 2 in the Aggregate Gradation Table	

4. The Engineer may authorize a change in gradation subject to materials locally available at the time of construction.

F. Water Requirements: Comply with Iowa DOT Section 4102. Potable water obtained from a municipal supply, suitable for drinking, may be accepted without testing.

G. Admixtures: Meet Iowa DOT Materials I.M. 403 and the requirements for the liquid admixtures shown below. Other admixtures may be used subject to the approval of the Engineer.

1. Air Entrainment Admixture: Comply with Iowa DOT Section 4103.

2. Retarding and Water Reducing Admixtures: Comply with Iowa DOT Section 4103.

3. Accelerating admixtures (calcium chloride): Comply with Iowa DOT Article 2529.02.

H. Bars: Comply with Iowa DOT Section 4151 for metallic tie bars and dowel bars or Iowa DOT Section 4156 for glass fiber reinforced polymer dowel bars. Meet the tie bar requirements for bar mats. All metallic bars must be epoxy coated.

I. Expansion Tubes: Comply with Iowa DOT Section 4191.

J. Metal Keyways: Comply with Iowa DOT Section 4191.

K. Supports for Bars: Comply with Iowa DOT Materials I.M. 451.01.

L. Joint Fillers and Sealers:

1. Joint Sealers: Comply with Iowa DOT Article 4136.02.

2. Preformed Expansion Joint Fillers and Sealers: Use the following types of preformed materials for filling expansion joints that comply with Iowa DOT Article 4136.03. When the type is not specified, use a resilient filler.
- Resilient filler
- Flexible foam expansion joint filler
- Tire buffings expansion joint filler

- Elastomeric joint seals

M. Liquid Curing Compound: Comply with Iowa DOT Section 4105.

N. Covering:

1. **Burlap:** Comply with Iowa DOT Section 4104.

2. **Plastic Film:** Comply with Iowa DOT Section 4106.

3. **Insulating Cover:** Comply with Iowa DOT Section 4106.

O. Grout Systems: Use polymer grouts that comply with Iowa DOT Materials I.M. 491.11.

2.02 CONCRETE MIXES

A. Mix Design:

1. Comply with Iowa DOT Class C or Class M mix meeting the requirements of Materials I.M. 529. If higher durability mixes are specified, use C-SUD or CV-SUD mixes.

2. Ensure compatibility of all material combinations. If the concrete materials are not producing a workable concrete mixture, a change in the material may be required. Changes will be at no additional cost to the Contracting Authority.

B. Consistency and Workability:

1. **Slump:**
   a. Use an amount of mixing water that will produce workable concrete of uniform consistency. Unless specifically modified by the Engineer, ensure slump, measured according to Iowa DOT Materials I.M. 317, is no less than 1/2 inch or no more than 2 1/2 inches for machine finish and no less than 1/2 inch and no more than 4 inches for hand finish.
   b. If it is not possible to produce concrete having the required consistency without exceeding the maximum allowable water to cement ratio specified, the cement content may be increased or water reducing admixture may be added. Obtain the Engineer's approval. Do not exceed the maximum water to cement ratio. Additional cement or water reducer will be added with no additional cost to the Contracting Authority.
   c. The basic absolute volume of water per unit volume of concrete is based on average conditions. If material characteristics require that the total quantity of water used to secure the required consistency reduces the batch yield (computed on the basis of absolute volumes of the batch quantities used) by more than 2.0%, the Engineer may adjust the proportions to correct the yield. This adjustment will not be a basis for adjustment of the contract unit price.

2. **Air Content:** Use an approved air entraining agent.
   a. For machine-placed pavement, use a target air content of 8% with a tolerance of plus or minus 2% when measured on the grade just prior to consolidation, as determined by Iowa DOT Materials I.M. 318. The target air content may be adjusted by the Engineer based on random tests of the consolidated concrete behind the paving machine. These additional tests will be used to consider the need for a target value change and will not be used in the acceptance decision.
   b. For hand-placed pavement, use a target content for hand finish of 7% with a tolerance of plus or minus 1.5% when measured on the grade and just prior to consolidation, as determined by Iowa DOT Materials I.M.

318.

C. Use of Fly Ash and Ground Granulated Blast Furnace Slag (GGBFS) as Supplementary Cementitious Materials:

1. Mix proportions for the various mixes using fly ash and GGBFS are included in Iowa DOT Materials I.M. 529. The maximum allowable fly ash substitution rate is 20%. Do not use a GGBFS substitution rate of more than 35% by weight (mass). The total supplementary cementitious material substitution rate is not to exceed 40%.

2. If C-SUD or CV-SUD mixes are specified, the maximum allowable Class F fly ash substitution rate is 25% and the maximum Class C fly ash substitution rate is 35%. The maximum combination rate is 20% Class C fly ash and 20% GGBFS.

3. When Type IP or IS cement is used in the concrete mixture, only fly ash substitution will be allowed. Between October 16 and March 15, supplementary cementitious materials will be allowed only when maturity method is used to determine time of opening. Transport, store, haul, and batch fly ash and GGBFS in such a manner to keep it dry.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Batching and Mixing Equipment:

1. General:
- **a. Weighing and Proportioning Equipment:** Comply with Iowa DOT Article 2001.20.
- **b. Mixing Equipment:** Comply with Iowa DOT Article 2001.21.
- **c. Material Bins:** Involves any structure in which materials are stored. Each part of any bin, including foundations and supports, must be adequate to withstand any stress to which it might be subjected to while in use.

2. Batching:
- a. Ensure the batching plant is Iowa DOT calibrated and approved. Provide copy of current calibrations and approvals.
- b. Coordinate the batch plant operation and batch trucks with the paving operation in order to ensure a steady supply of materials.
- c. Operate the batch plant and trucks to minimize dust, noise, or truck nuisances.

3. Mixing:
- **a. Construction or Stationary Mixer:**
  - 1) Ensure the concrete is uniform in composition and consistency. If this condition is not produced because of the size of the batch, the size of the batch may be reduced or the mixing time increased, or both, until this result is obtained. If non- uniform, corrective action must be taken.
  - 2) Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and they will facilitate placing with a minimum of handling.
- **b. Ready Mixed Concrete:**
  - 1) Ensure the concrete is uniform in composition and consistency. If non-uniform, concrete producers must take corrective action.
  - 2) Ready mixed concrete is defined as concrete proportioned in a central plant and mixed in a stationary mixer for transportation in trucks without agitation, proportioned at a central plant, and only partially mixed in a stationary mixer for transportation and finish mixing in a transit mixer, or

proportioned at a central plant, and then mixed in a transit mixer prior to or during transit.

3) When necessary to add additional mixing water at the site of placement, mix the batch at least an additional 30 revolutions of the drum at mixing speed.
4) Ensure each vehicle in which concrete will be delivered is capable of discharging concrete having a slump not over 2 inches at an overall rate for its entire load of not less than 1.25 cubic yards per minute. Ensure the concrete is delivered at a rate sufficient to maintain a sustained rate of progress of not less than 100 feet per hour for the width and depth of pavement to be placed.

c. All Methods: Identify each truck load by a plant charge ticket showing plant name, contractor, project data, quantity, class, time batched, and water added at site.

B. Concrete Delivery Equipment:

1. General:

a. In handling concrete from the mixer to the place of deposit, take care to avoid segregation.
b. When concrete is deposited through a chute, slope the chute to allow concrete to flow slowly without segregation. Place the delivery point of the chute as close as possible to the point of deposit. Keep chutes and spouts clean. Thoroughly flush them with water before and after each run. Discharge the water outside the paving area in an approved concrete washout area.
c. Provide alternate plan for concrete delivery in event of equipment failure.
d. Take concrete samples from material placed on the subgrade or subbase.

2. Concrete Transfer Equipment:

a. Utilize placers, conveyors, buckets, or buggies designed specifically for transporting concrete.
b. Do not allow concrete to free fall into or out of transfer equipment.
c. Meet the requirements of Section 32 13 13, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.

3. Concrete Pumps:

a. Do not pump concrete through aluminum conduit or tubing.
b. Use the concrete pump to deliver the material as close to horizontal as possible, keep restrictions and drops to a minimum, and avoid free fall.
c. Meet the requirements of Section 32 13 13, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.
d. Sample the first load after pumping a minimum of 3 cubic yards. Sample after each significant change in boom angle.
e. Sample before and after the pump to determine if any changes in the slump and other significant mixture characteristics occur.
f. When sampling at the end of the placement line, take care to ensure that the sample is representative of the concrete being placed from the pipeline. Note: Changes to the placement rate or boom configuration can result in changes in the concrete properties. Typically, the vertical position of the boom results in the greatest potential for air loss while the horizontal position of the boom has the least potential. Location of pumping equipment should be determined so that it is possible to maintain a consistent, low boom angle as much as possible during placement.
g. If air test shows that air entrainment is outside of the allowed range, follow procedure as outlined in Section 32 13 13, 3.07, B.
h. Leaks in the line or pump hydraulics, which would allow air to be added

to the concrete, are prohibited.

C. Concrete Placement Equipment:

1. Consolidating and Finishing Equipment:

a. Use a paving machine that meets all of the following:
   1) Is designed for the specific purpose of placing, consolidating, and finishing concrete pavement.
   2) Develops vertical edges on the pavement.
   3) Is self propelled and equipped with a means for spreading the concrete to a uniform depth before it enters the throat.
   4) Vibrates the concrete to the full width and depth being placed in a single passage. Use vibrating tubes or arms working in the concrete or a vibrating pan operating on the surface of the concrete.
   5) Produces a surface reasonably free of voids and tears.
   6) When the paver is operated on previously placed concrete, prevent damage to the pavement surface.
   7) For slip form pavers, use a paver equipped with automatic horizontal and vertical grade controls.

b. Hand methods utilizing air screeds and vibrating screeds may be used for short pavement runs, cul-de-sacs, driveways, and some intersections.

c. When allowed by the Engineer, use stringless paving equipment capable of providing the same accuracy necessary to comply with the requirements of Section 32 13 13.

d. Use a laser guided screed that meets all of the following:
   1) Designed for the specific purpose of placing and finishing of concrete pavement using a 3-dimensional surface model.
   2) All equipment for laser guided screed, including the guidance system, will meet the project design model tolerances.
   3) Will provide consolidation to full width and full depth of concrete placement. Provide intermediate consolidation by using external hand held vibrators.
   4) Produces a surface reasonably free of voids and tears.
   5) Provide boom-style screed (drive-in screeds are not allowed) with an auger boom, placement head (water spray mechanism not allowed), guidance equipment, and software to produce 3-dimensional surface.
   6) Produces pavement smoothness as specified in Section 32 13 13, 3.07, C.

2. Vibrators for Machine Paving:

a. Consolidate, with a single pass of an approved internal or surface vibrator, the full width and depth of concrete requiring a finishing machine. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute. The Engineer may authorize the minimum vibration frequency to be lowered to 3,500 vibrations per minute for particular sections of paving, such as superelevations. Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.

b. Avoid operating vibrators in a manner to cause a separation of the mix ingredients, either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. When forward motion of the paver is reduced, vibrator frequency may need to be reduced to avoid separation of the mix.

c. If a vibrator fails to operate within the specifications, repair or change the vibrator before the paving begins:
   - The following day, or
   - The same day if the continuous paving that day is stopped at a header or at the end of a session.

d. If two adjacent vibrators fail to operate within the specifications, stop the paving operation and repair or replace the vibrators.
e. Stop vibrators whenever forward motion of the paver is stopped.
f. Set the internal vibrator penetration depth into the concrete pavement to mid slab or as deep as possible while passing above reinforcing steel. Provide an operating position locking device so that no part of the vibrating unit can be lowered to the extent that it will come in contact with reinforcing steel or tie bars while paving.
g. Do not exceed the manufacturer's recommendations for vibrator horizontal spacing. Do not exceed 16 inches from center to center.
h. Mount the longitudinal axis of the vibrator body approximately parallel to the direction of paving. Tilt the trailing end of each vibrator downward to a slope of 10 to 30 degrees below horizontal.
i. Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of 10,000 vpm:
    1) Amplitude (peak to peak) 0.070 inches.
    2) Centrifugal force 1,200 pounds.

3. **Vibrators for Hand Methods:** Use a vibration rate between 3,500 to 6,000 vibrations per minute, and use an amplitude sufficient to be perceptible on the surface of the concrete more than 12 inches from the vibrating unit.

4. **Hand Finishing Equipment:** Provide all finishing tools necessary for proper finishing of the concrete including straightedges for checking and correcting finished concrete surfaces.

5. **Forms:**
    a. **Rigid Forms:** Steel, minimum thickness of 5 gage, height at least equal to design thickness of pavement with base width at least 6 inches.
        1) Minimum section length of 10 feet, joint connections designed to allow horizontal and vertical adjustment with locking device to hold abutting sections firmly in alignment.
        2) Bracing, support, and staking must prevent deflection or movement of forms.

    b. **Flexible Forms:** Use steel or wood flexible forms for curves with a radius less than 100 feet.
        1) Bracing, support, and staking must prevent deflection or movement of forms.
        2) Ensure that forms used to shape back of curbs at returns have height at least equal to design thickness of pavement and curb height.
        3) Forms must be free from scale and surface irregularities.

6. **Curing Equipment:** Use pressure sprayer capable of applying a continuous uniform film of curing compound. Use equipment with a shield if wind conditions do not allow proper coverage

7. **Concrete Saws:** Use power operated concrete saws capable of cutting hardened concrete neatly.

8. **Joint Sealing Equipment:** Use equipment capable of cleaning the joint and heating and installing sealant in joints according to manufacturer's recommendations.

3.02 PAVEMENT CONSTRUCTION

A. Removal of Pavement: Comply with Section 32 13 15, 3.02.

B. Final Subgrade/Subbase Preparation:

1. General:
a. Meet the requirements of Section 31 20 00 for subgrade construction, subgrade treatment, and subbase construction.
b. Trim the subgrade or subbase to the final grade for placement of concrete.
c. Unless otherwise ordered by the Engineer, the subgrade or subbase, at time of placing concrete for concrete pavement, must be in a uniformly moist but not muddy condition to a depth of not less than 1 inch.

2. Subgrade and Subbase Loading:
a. Travel of concrete delivery trucks on a subgrade or subbase must be approved by the Engineer. In such cases, watering of the subgrade or subbase must be limited to just ahead of the paving machine.
b. Enter and exit from side streets to minimize repetitive loading on the subgrade or subbase by concrete trucks.
c. Do not allow loads in excess of the legal axle load on the completed subgrade or subbase.
d. Partially loaded trucks may be required.
e. If subgrade or subbase failure occurs, coordinate the repair with the Engineer.

3. Paving Suspended:
a. Suspend the paving operation where subgrade or subbase stability has been lost.
b. Do not place concrete on a subgrade or subbase that has become unstable, bears ruts or tire marks of equipment, or that is excessively softened by rain until such subgrade or subbase has been reconsolidated and reshaped to correct the objectionable condition.
c. If necessary, scarify to a minimum depth of 6 inches, aerating, and recompacting at no additional cost to the Contracting Authority. Meet the compaction requirements of Section 31 20 00.

4. Maintenance of Subgrade or Subbase: Maintain the completed subgrade or subbase during subsequent construction activities.

C. Surface Fixture Adjustment:

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 33 42 31 for manhole adjustments and Section 33 14 23 for water fixture adjustments.

2. Clean outside of fixture to depth of pavement before concrete placement.

3. Construct boxouts where allowed for later adjustment of fixtures. See SUDAS Figure 7010.103 for the size and shape of the boxout.

D. Setting of Forms: When forms are used, meet the following requirements.

1. Ensure forms have sufficient strength to support paving operations being used.

2. Set base of forms at or below subgrade elevation with top of forms at pavement surface elevation. With Engineer approval, extra height forms may be used to shape the back of integral curb and edge of pavement; set base at or below subgrade elevation with top of form at top of curb elevation.

3. Place and secure forms to required grade and alignment. Do not vary the top face of the form from a true plane by more than 1/8 inch in 10 feet, and do not vary the

vertical face from a true plane by more than 1/4 inch in 10 feet.

4. If the soil supporting the forms is softened by rain or standing water so that the forms are inadequately supported, or if voids occur under the forms, remove forms. Rework subgrade to proper elevation and density, and reinstall forms.

5. Ensure forms are free of latent concrete and coated with release agent before concrete is placed.

E. Bar and Reinforcement Placement: Ensure bars are clean, straight, free from distortion and rust, and are firmly secured in position as specified in the contract documents. Place all bars in approved storage to prevent damage; do not distribute along the work site except as needed to avoid delay in paving.

1. Tie Bars:

a. Place bars prior to vibration. For slip form paving, tie bars may be installed after vibration, provided the concrete is consolidated around the bars. Bars may be supported by approved chairs or may be placed in position by a machine or method approved by the Engineer.

b. Use approved continuous bolsters with runners to support reinforcement for bridge approach sections. Place the supports transversely across the approach and space them longitudinally no greater than 4 feet. For double reinforced approach sections the top layer of reinforcing may be chaired off the bottom layer of reinforcing using approved continuous high chairs with runners, provided they are positioned directly above the continuous bolsters with runners supporting the bottom layer of reinforcing. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires.

2. Dowel Bar Assemblies:

a. When dowel bar assemblies are required in the contract documents, accurately place these assemblies as shown. To prevent their movement during subsequent concrete paving operations, securely stake or fasten to the base to line and grade.

b. Do not use assemblies that are damaged prior to placement. If assemblies are damaged after placement, replace prior to paving. Ensure horizontal and vertical alignment of the load transfer bars does not exceed 1/4 inch from parallel to line and grade. Place each assembly so the bars are in a horizontal plane at T/2 ± 1/2 inch.

c. Check the placement of each assembly and the position of the bars within the assembly using a suitable template or other device approved by the Engineer. If the assembly is found to be placed outside of the above tolerances, correct the placement.

d. Cutting the tie wires of the load transfer assemblies is optional.

3. Bar Mats for Reinforced Pavement:

a. When reinforced pavement is specified, assemble bar mats accordingly and firmly fastened together at all bar intersections.

b. Place, secure, latch, and tie bar mats for a continuous mat as specified in the contract documents. Displacement during concrete placement operations is not allowed.

c. Use chairs to ensure proper placement of bar mats.

4. Tie Bars and Dowel Bars in Existing Pavement:

a. When anchoring in existing concrete, use a grout system according to the manufacturer's instructions. Obtain the Engineer’s approval for the grout system.

b. For horizontal installations, use either a pressure injection system with mechanical proportioning and mixing, or use encapsulated chemical anchors. Install as follows:
   1) Ensure drilled holes to receive the grout match the dimensions and spacing specified in the contract documents. When not specified in the contract documents, the maximum nominal diameter of the hole must be 1/8 inch larger than the outside diameter of the dowel or bar, or as recommended by the manufacturer. Drill holes for tie bars and dowel bars into the face of the existing pavement at midpoint. To ensure proper horizontal alignment, do not allow any hole misalignments to exceed 1/4 inch in the vertical or horizontal plane. Clean the hole with compressed air immediately prior to placing the grout.
   2) Use a polymer grout to secure the dowels in the existing pavement. Inject the grout into the rear of the hole with pressure. Use sufficient grout so that when the bar to be grouted is placed in position, excess grout will be forced out the front of the hole. Rotate the bar during the insertion process to ensure complete coating with the grouting material. Hand proportioning and mixing is not allowed.
   3) If using grout with approved encapsulated anchors, install according to the manufacturer's recommendations.
   4) Use horizontal installation procedures for vertical or angled installations; however, pourable grouts may be used. Pourable grouts must be mechanically mixed.

F. Concrete Pavement Placement:

1. Use paving machine for all uniform width pavements 8 1/2 feet or more in width and 250 feet or more in length, unless alternate methods are approved by the Engineer. Screeds and laser guided screeds may be used on short pavement runs up to 250 feet.

2. Place, consolidate, and finish the concrete to the full depth and width conforming to the specified crown and cross-section in a single operation.

3. Keep a uniform pile of concrete in front of the paving machine, up to a maximum of 6 to 8 inches above the design surface elevation. Distribute and spread the concrete as soon as placed. A mechanical concrete spreader may be used.

4. Deposit the concrete upon the in-place bars keeping segregation to a minimum.

5. Use shovels, not rakes, to do necessary hand spreading and spading.

6. Do not allow the edges of pavement, including all longitudinal construction joints, to deviate from the line shown on the plans by more than 1/2 inch at any point.

7. If the paving machine operates on adjacent pavement, protect pavement from damage.

8. When placing by hand methods, consolidate the concrete by using vibrating units. Use a definite system or pattern in the operation of the vibrator so the full width of concrete in each linear foot of lane will receive adequate and uniform consolidation. The system and methods of vibrating is subject to approval of the Engineer. Do not use vibrating equipment as a tool for moving concrete laterally.

9. Stringless Paving:
   a. Provide an electronic file identifying x, y, and z coordinates for curbs and

pavement edges, as well as pavement centerline based on project alignments and elevations.

b. Location and elevation of the finished slab should be verified against grade check hubs at 25 foot intervals for the first 100 feet of each days run and at critical locations, such as intakes and through intersections where grades may be flat. The Engineer may waive these requirements if experience has shown compliance with the design elevations.
c. Record each verification check and submit to the Engineer.
d. At the beginning of paving operations on the project or after each modification to the paving machine, verify the paving equipment is calibrated per the manufacturer's recommendations.

G. Integral Curbs: Integral curbs are placed with the pavement in a single paving machine operation; however, hand methods may be allowed for radius, returns, and sections of curb and gutter 100 feet or less in length or in other special sections where mechanical equipment cannot be used.

1. Pave, edge, protect, saw, and cure curb in same manner as pavement.

2. Finish curb as rapidly as finishing operations on pavement permit. Maximum distance behind paving machine is 100 feet.

3. Complete final finish on curbs by hand methods, including the use of a 6 foot straightedge.

4. Check surfaces of curb and gutter with 10 foot straightedge; correct variations greater than 1/8 inch. Ensure top of curb slopes to street when Class A sidewalk will be constructed adjacent to the curb.

5. For drop curb at driveways and where sidewalks intersect streets, use forms to shape the backs of such curbs.

6. When using hand methods for building curb, the following additional requirements will apply:
   a. Remove free water, latency, dust, leaves, or other foreign matter from the slab prior to placing concrete for curb.
   b. Use freshly mixed concrete; do not store concrete in receptacles at side of pavement for use in curb at a later time; do not use concrete requiring retempering.
   c. Consolidate curb concrete to obtain adequate bond with the pavement slab and to eliminate honeycomb in the curb. Avoid disturbing the alignment of forms or the gutter flow line.

H. PCC Railroad Crossing Approach: Construct according to Section 32 13 13 and SUDAS Figure 7010.903. Construct asphalt section according to the full depth patch requirements of Section 32 13 15.

I. Finishing:

1. Grade and Crown: Promptly after concrete has been placed and vibrated, strike off the surface to the true section by the screed. Finish the surface true to crown and grade.

2. Watering the Surface: The practice of lubricating the pavement surface by sprinkling water by spray, brush, or other methods to afford greater ease in finishing operation is not allowed.

3. **Floats:** Finish surface with wood or magnesium floats; finish from both sides simultaneously if pavement is placed to full width with one pass of paving machine.

4. **Straightedging:**
   a. After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, test the pavement surface for trueness.
   b. Immediately fill any depressions found with freshly mixed concrete, struck off, consolidated, and refinished.
   c. Check surface longitudinally while concrete is still plastic; correct any surface deviations greater than 1/8 inch in 10 feet.

5. **Surface Treatment:**
   a. Drag Surface Treatment: Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.
      1) Pull the artificial turf or burlap drag longitudinally over the finished surface to produce a tight, uniform, textured surface, and round the edges in a workmanlike manner.
      2) Remove the artificial turf or burlap drag from the pavement surface at regular intervals and clean with water to remove accumulated concrete from the fabric in order to maintain a consistent finished texture.
      3) When the desired texture is not attained, the Engineer may require the final finish be a broom finish.

   b. Surface Tining: When surface tining is specified, use a longitudinal tining. Under special circumstances, when specified in the contract documents, transverse tining may be required.

      1) Longitudinal:
         a) Complete longitudinal surface tining using a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and uniformly spaced at 3/4 inch intervals. The depth of the grooves must be a minimum of 1/8 inch to a maximum of 3/16 inch in the plastic concrete.
         b) Use equipment with horizontal and vertical string line controls to ensure straight grooves.
         c) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
         d) At longitudinal joints, leave a 2 to 3 inch wide strip of pavement surface (centered along the joint) that is not grooved for the length of the joint.

      2) Transverse:
         a) If transverse surface tining is required or allowed, use a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and randomly spaced from 3/8 inch to 1 5/8 inch with no more than 50% of the spacing exceeding 1 inch. The depth of the grooves must be a minimum of 1/8 inch to a maximum of approximately 3/16 inch in the plastic concrete.
         b) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
         c) Where abutting pavement is to be placed, the tining should extend as close to the edge as possible without damaging the edge.
         d) If abutting pavement is not to be placed, do not tine the 6 inch area nearest the edge or 1 foot from the face of the curb.

6. **Edge Finish:** Before the concrete has taken its initial set, finish all edges of the pavement with an 1/8 inch radius edging tool.

7. **Honeycomb Repair:** When paving without forms, fill any honeycombed area immediately with freshly mixed concrete and work into the slab prior to initial set and the application of curing. Failure to do so may prompt the Engineer to declare the work defective and cause it to be removed and replaced at no additional cost to the Contracting Authority.

J. Surface Curing:

1. Apply liquid curing compound in a fine spray to form a continuous, uniform film on the horizontal surface and vertical edges of pavement, curbs, and back of curbs immediately after surface moisture has disappeared, but no later than 30 minutes after finishing. With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties to ensure acceptable macrotexture is achieved.
   a. Use a white pigment liquid curing compound for concrete not receiving an asphalt overlay. When specified in the contract documents, use a linseed oil solution.
   b. Use a dark-colored curing compound for concrete receiving an asphalt overlay.

2. Apply compound with power sprayer; rate of application not less than 15 square yards per gallon (0.067 gallon per square yard); do not dilute compound. For concrete receiving an asphalt overlay, use a minimum rate for dark-colored cure of 12.5 square yards per gallon (0.08 gallon per square yards).

3. Ensure liquid curing materials are well agitated in the supply drum or tank immediately before transfer to the sprayer. Keep curing materials well agitated during application.

4. Hand operated sprayers may be used for small and irregular areas.

5. If forms are used, apply to pavement edges and back of curbs within 30 minutes after forms are removed.

6. If, due to other operations, the coating is damaged within 72 hours after being applied, immediately re-coat the affected areas. Coating of the sawed surface with curing compound will not be allowed on joints that are to be sealed. When pavement is opened to traffic prior to 72 hours after application of the curing coating, a re-coating will not be required.

K. Construction of Joints:

1. General:
   a. Construct joints of the type, dimensions, and at the locations specified in the contract documents. See the SUDAS 7010 figures.
   b. Place longitudinal joints coincident with or parallel to the pavement centerline.
   c. Place all transverse joints at right angles to the centerline and extend the full width of the pavement.
   d. Place all joints perpendicular to the finished grade of the pavement and do not allow the alignment across the joint to vary from a straight line by more than 1 inch.
   e. Exercise care in placing, consolidating, and finishing the concrete at all joints.

2. Saw Joints:
   a. Mark joint locations with a string line before sawing.
   b. Begin transverse joint sawing as soon as the concrete has hardened sufficiently

to allow sawing without raveling or moving of aggregate. Saw joints before uncontrolled cracking takes place.

c. Saw all joints in a single cutting operation for a specific joint. Make saw cuts true to line and to the dimensions specified in the contract documents.
d. Discontinue sawing a joint if a crack develops ahead of the saw.
e. Saw longitudinal joints within 24 hours of the concrete being placed.
f. If necessary, continue the sawing operations both day and night.
g. The concrete must be capable of supporting the sawing operations to allow the use of an early green concrete saw.
h. Repair or replace pavement with uncontrolled or random cracking at no additional cost to the Contracting Authority. Use repair methods approved by the Engineer. Repair or replace at the direction of the Engineer.
i. Use wet sawing for dust control when specified in the contract documents.
j. Where boxouts occur in pavement, construct joints as shown on SUDAS Figures 7010.103 and 7010.904.

3. Construction Joints:

a. Place longitudinal and transverse construction joints where specified in the contract documents, at boxouts, and at headers.
b. Locate and place forms for boxouts on grade prior to paving as shown on SUDAS Figures 7010.103 and 7010.904.
c. Construct a Days Work (DW) or a Rigid Tie (RT) transverse construction joint no closer than 5 feet of an existing or planned transverse contraction joint. Construct the DW or RT transverse construction joint if concrete placement is delayed for more than 30 minutes, at planned pavement gaps, or at the end of each day.
d. Finish the edges of the pavement at construction joints with a 1/8 inch radius edging tool.

4. Expansion Joints:

a. Install expansion joints as specified in the contract documents.
b. Prevent movement of or damage to joint assembly when placing concrete; set joint material low enough to clear the finish machine.
c. Construct double width expansion joint in curb over expansion joint in pavement. The backside of the joint must be clear of concrete.
d. Align the expansion joint straight and true. After the mechanical finishing equipment has passed over the joint, check the joint for movement. If movement in excess of 1/2 inch has occurred, immediately correct the installation to its intended position.
e. If joint fillers are assembled in sections, or if joints as a whole are constructed in sections, do not allow offsets between adjacent fillers.
f. Where more than one section is used in a joint, securely lace or clip the sections together.
g. Supplemental vibration equipment is required for proper consolidation of the concrete.
h. After the surface finishing has been completed, finish the edge of the joint with a 1/8 inch edging tool.

L. Joint Sealing:

1. Timing:

a. Unless otherwise allowed or approved by the Engineer, before any portion of the pavement is opened to the Contractor's equipment or to general traffic, clean and seal joints that require sealing.
b. The Engineer may limit the wheel loads and axle loads of equipment operating on the pavement during this operation, if prior to the age and strength specified

in Section 32 13 13, 3.05. Additional tests to determine the pavement strength may be required.

2. **Cleaning:**
   a. For those joints that are not to be sealed, cleaning is not required.
   b. Within 3 hours after a joint has been wet sawed to the finished dimension, flush the wet sawing residue away from the sawed faces using a high pressure water blast operating with a minimum pressure of 1,000 pounds per square inch. Within 3 hours after a joint has been dry sawed to the finished dimension, blow the dry sawing residue from the joint using air compressors that provide moisture and oil free compressed air.
   c. Immediately prior to installation of sealant, clean joints with an air blast. Do not perform sealing until visual examination verifies the joint surfaces appear dry, in addition to being clear of dust and contamination.

3. **Sealing:**
   a. Prepare and install joint sealer in the joint and to the proper level specified in the contract documents and as recommended by the manufacturer.
   b. Heat hot-poured sealers in a thermostatically controlled heating kettle; heat the material to the temperature required for use, but not above that recommended by the manufacturer. After sealing, remove excess sealer from the pavement surface.
   c. Seal joints the same day they are cleaned. Apply sealant only when the joint surfaces appear dry by visual examination.
   d. Place joint sealer only when the pavement and ambient air temperatures are 40°F or above. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint faces. When this sealer cannot be properly placed due to late fall work, submit a joint construction plan and sealing details to the Engineer for approval before commencing paving. Delay the cleaning, sealing, and, if required, resawing of joints until the following spring. This delay requires the Engineer's approval.
   e. When surface correction is required, repair seals damaged from the corrective work. Joint preparation, cleaning, and sealing may be delayed until after corrective work, provided the pavement is not opened to traffic before corrective work is performed.

M. Pavement Backfill: Following slipform paving operations, place backfill material along the pavement within 48 hours of pavement attaining opening strength or as directed by the Engineer to prevent flow of water and any subsequent damage caused by undermining of the pavement. Prior to placement of full backfill material, construct check dams or other protection as appropriate to ensure no damage to the subgrade and/or subbase occurs.

N. Form Removal:

1. **Timing:**
   a. Remove forms after the initial set of the concrete has taken place.
   b. Remove stakes and forms with care to prevent cracking, spalling, or over stressing concrete. If damage does occur, repairs will be made as required by the Engineer.

2. **Honeycomb Repair:**
   a. When the forms are removed, fill honeycombs with mortar composed of 1 part cement and 2 parts fine aggregate by weight.

b. If the honeycombing is to the degree and nature that it is considered by the Engineer as defective work, remove and replace at no additional cost to the Contracting Authority.

3. Paving Protection: In the area adjacent to the curbs and pavement edge, immediately place backfill after the forms are removed. Construct dams or other protection to ensure that no saturation or erosion of the subgrade under or near the pavement occurs. This may include check dams, pumping, etc.

3.03 CURB AND GUTTER CONSTRUCTION (See SUDAS Figure 7010.102)

A. Complete the construction of curb and gutter separate from pavement in the same manner as for pavement in Section 32 13 13, 3.02.

B. Use a paving machine for curb and gutter. For curb and gutter sections less than 250 feet, hand finish methods may be used.

3.04 PAVEMENT PROTECTION

A. Weather Conditions: Do not place concrete when stormy or inclement weather or temperature prevents good workmanship. Temperature restrictions and protection requirements may be modified by the Engineer under unusual conditions.

1. Cold Weather:

a. Paving: Do not place aggregates containing frozen lumps, and do not place concrete on a frozen subgrade or subbase. Take all necessary actions to prevent the pavement from freezing.

1) Concrete mixing and placement may be started, if weather conditions are favorable, when the air temperature is at least 34ºF and rising. At the time of placement, concrete must have a temperature of at least 40ºF.

2) Stop mixing and placing when the air temperature is 38ºF or less and falling or if the temperature stops rising and does not reach 38ºF.

b. Protection: Prior to applying protection, cure all concrete pavement and curb/gutters, including exposed edges of the pavement and curb. In addition, protect concrete less than 36 hours old as follows:

Night Temperature Forecast	Type of Protection[1]
35°F to 32°F	One layer of burlap for concrete.
31°F to 25°F	Two layers of burlap or one layer of plastic on one layer of burlap.
Below 25°F	Four layers of burlap between layers of 4 mil plastic or equivalent commercial insulating material approved by the Engineer.

[1] Keep protection in place until one of the following conditions is met:
a. The pavement is 5 calendar days old.
b. Opening strength is attained.
c. Forecasted low temperatures exceed 35°F for the next 48 hours.
d. Forecasted high temperatures exceed 55°F for the next 24 hours and subgrade temperatures are above 40°F.

1) Shut down paving operations in time to comply with protection requirements outlined above. During cold weather, allow more time for finishing and protection. Perform all finishing and covering operations

prior to darkness. Temperature restrictions and protection requirements may be modified by the Engineer.

2) Equivalent commercial insulating material approved by the Engineer may be used. This material must be waterproof and have a minimum R value of 1.0. If initial set has not yet occurred, place a layer of burlap on top of concrete prior to placing insulating blankets.
3) Use a method of protection and materials that will maintain the concrete temperature above 40°F.

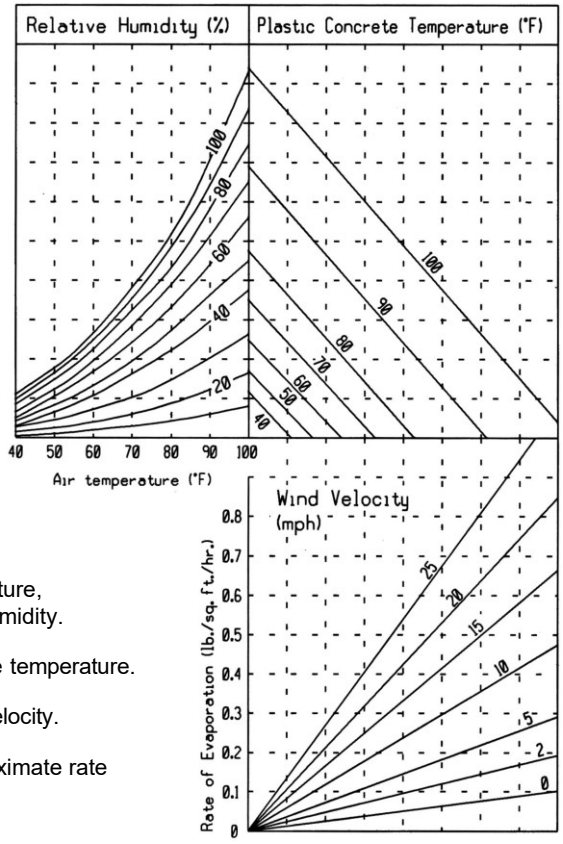
2. Hot Weather: Hot weather condition is defined as any combination of the following conditions that tend to impair the quality of plastic concrete by accelerating the rate of moisture loss and rate of cement hydration causing thermal shrinkage and resulting in plastic shrinkage cracking:

- High Ambient Temperature
- High Concrete Temperature
- Low Relative Humidity
- High Wind Velocity
- Solar Radiation

a. General:
   1) During hot weather conditions, the Engineer may restrict concrete placement to early morning or evening hours.
   2) During hot weather conditions, advise the Engineer of the results of the theoretical evaporation rate throughout paving operations.

b. Determine the Theoretical Rate of Evaporation: Use the following chart and the National Weather Service's predicted maximum air temperature, relative humidity, and maximum steady wind velocity without gusts, for the date and the location of the paving pour.

Theoretical Rate of Evaporation Chart



To Use this Chart:

1. Enter with air temperature, move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind velocity.
4. Move left , read approximate rate of evaporation

c. If the evaporation rate exceeds 0.1 pounds per square foot per hour but is less than 0.3 pounds per square foot per hour, provide the following concrete evaporation protection.
    1) Immediately apply an approved evaporation retarder to the concrete pavement and curbs or increase the surface cure application to 1.5 times the standard specified rate.
    2) Take special precautions to ensure that the forms and subgrade are sufficiently moist or protected to avoid lowering the water content at the pavement/subgrade interface. In hot weather conditions, moisten the subgrade the evening before operations.
    3) Ensure that the time between placing and curing is minimized and eliminate delays.
    4) Moisten concrete aggregates that are dry and absorptive.
    5) Use a fog spray to raise the relative humidity of the ambient air if there is a delay in immediately applying the curing compound.
    6) Minimize solar heat by shading, wetting, or covering concrete chutes or other equipment that comes in contact with plastic concrete.
d. If the evaporation rate is 0.3 pounds per square foot per hour or greater, discontinue placement of concrete.

3. Rain Protection:

a. Have materials available, near the work site, for proper protection of the edges and surface of concrete. Protective material may consist of sheets of burlap or plastic film. Also have planks or other material with suitable stakes that can be used as temporary forms available.
b. If initial set has not occurred, take every precaution necessary to protect the surface texture of the concrete.
c. If so determined by the Engineer, failure to properly protect concrete will constitute cause for removal and replacement of defective pavement.

B. Night Conditions: Perform all finishing and covering operations prior to darkness (half an hour after sunset). Do not commence construction until half an hour before sunrise. Do not place or finish concrete under artificial light, unless approved by the Engineer.

C. Protection from Traffic:

1. General:

a. Protect the new pavement and its appurtenances from traffic, both public and that caused by the Contractor's own employees and agents, at no additional cost to the Contracting Authority. This includes the erection and maintenance of warning signs, lights, barricades, watchmen to direct traffic, and pavement bridges or crossovers.
b. Do not operate equipment with metal tracks, metal bucket blades, or metal motor patrol blades directly on new paving. Do not unload soil or granular materials, including base rock for storage and future reloading directly onto new paving.

2. End of Day's Run:

a. At the end of each day's run and at all side streets, erect and maintain safety barriers and fencing as necessary to protect the pavement from damage.
b. Install safety fences within 1 hour of the completion of finishing and curing operations. Leave fences in place and maintained until the concrete has attained the minimum strength or age.
c. Intermediate safety fences may be required for the purpose of opening the

pavement for access to a side road, side street, or entrance.

3. **Repair of Damages:** At the discretion of the Engineer, and at no additional cost to the Contracting Authority, repair or replace any part of the pavement damaged by traffic or other causes occurring prior to final acceptance of the pavement.

3.05 USE OF PAVEMENT

Time for opening pavement for use is determined by maturity method complying with Iowa DOT Materials I.M. 383 or age and test results. The minimum age and test results needed for opening are shown in Table 7010.01.

Table 7010.01: Minimum Age and Tested Strength of Pavement Before Opening

Class of Mix	Type of Cement	Minimum Age For Opening[1]	Minimum Compressive Strength (psi)	Minimum Flexural Strength Center Point (psi)
C	Type I	7 Days[2]	3,000	500
M	Type I	48 Hours	3,000	500

[1] Opening without testing only allowed upon approval of Engineer
[2] Five calendar days for concrete 9 inches thick or more.

3.06 TRANSPORTATION RESTRICTIONS

A. Do not use concrete transported with continuous agitation when the cement has been in contact with the aggregate more than 90 minutes before it is placed. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in Iowa DOT Materials I.M. 403.

B. Do not use concrete transported without continuous agitation if the period elapsed between the time the concrete is mixed and the time it is placed is greater than 30 minutes. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in Iowa DOT Materials I.M. 403 and the mixed-to-placed time may be extended.

C. Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and concrete placing will occur with a minimum of rehandling.

D. Thoroughly clean the truck compartment in which concrete is transported and flush with water to ensure that hardened concrete will not accumulate. Discharge the flushing water from the truck compartment to the designated discharge point before it is charged with the next batch.

3.07 QUALITY CONTROL

A. Testing: Provide the following material certifications and testing required to be performed by Supplier or Contractor.

Table 7010.02: Material Certifications and Testing

Material or Construction Item	Tests	Applicable Standard[1]	Methods of Acceptance of Sampling and Testing	Field Sampling and Testing	
				Frequency (minimum)	Responsible Party
Fine Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	Supplier/ Contractor
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Coarse Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Portland Cement	Quality	I.M. 401	Approved Source	Prior to use	
Fly Ash	Quality	I.M. 491.17	Approved Source	Prior to use	
GGBFS	Quality	I.M. 491.14	Approved Source	Prior to use	
Curing Compound	Quality	Iowa DOT Section 4105	Approved Source	Prior to use	
Joint Sealer	Quality	I.M. 436.01	Approved Source	Prior to use	
Epoxy Dowel Bars and Assemblies	Quality	I.M. 451.03B	Approved Source	Prior to use	
Tie Bars	Quality	I.M. 451	Approved Source	Prior to use	
Plastic Concrete	Air Content	I.M 318, 327	Field Test	1/200 CY or min. 1/day	Engineer
	Slump	I.M. 317	Field Test	1/200 CY or min. 1/day	
	Cylinders	I.M. 315	Field Test	Set of 3/500 CY or two sets/day	
	Beams	I.M. 316, 327, 328	Field Test	Set of 3/500 CY or two sets/day	
	Thickness	----------	Field Test	1/200 CY	
Hardened Concrete	Smoothness	SUDAS 7010, 3.07	Field Test - Straightedge	Project length	
	Smoothness	SUDAS 7010, 3.07	Field Test - Profilograph	Project length	Contractor
	Thickness	SUDAS 7010, 3.07	Field Test	1 core/1000 SY or 3 cores/project	
	Strength	I.M. 383	Maturity Tests[3]	Prior to placement	

[1] Refers to the Iowa DOT Materials I.M.s, Iowa DOT Standard Specifications, or SUDAS Standard Specifications.
[2] Certified plant inspection per Iowa DOT Materials I.M. 527.
[3] The Contractor is responsible for developing the maturity curve for the specified mix, taking maturity readings, and delivering a copy of the results to the Engineer.

B. Air Content:

1. Air content of the concrete will be evaluated according to Iowa DOT Materials I.M. 318 and 327.

2. When a test result is outside the tolerance for the target air content, the contractor will be notified immediately. An air test will then be immediately run behind the paver to aid in identifying the limits of the non-complying air. A test result between 5% and 8% behind the paver will be considered complying. This test will represent all concrete from the back of the paver back to the last documented complying test. Make immediate adjustments to the mix production and placement process to bring

the air content back within tolerance. Do not use succeeding loads below the lower target air content tolerance by more than 0.5%. Each subsequent load will be tested until air content is within tolerance for two consecutive loads. For all incorporated, non-complying concrete that is out of tolerance, the Engineer will determine if removal and replacement is required or if a price adjustment, according to Table 7010.03, will be applied.

Table 7010.03: Concrete Air Content Price Adjustments

Air Content Range			% Payment of Unit Price
Minimum		**Maximum**	
1.1*	and	below	0%
0.6	to	1.0*	50%
0.1	to	0.5*	75%
Low air tolerance limit			100%
Target			100%
High air tolerance limit			100%
0.1	to	0.5**	95%
0.6	to	1.0**	85%
1.1	to	1.5**	75%
1.6	to	2.0**	60%
2.1**	and	above	0%

*Air content deviation below the acceptable limits
** Air content deviation above the acceptable limits

C. Pavement Smoothness: Evaluate pavement smoothness for all PCC pavement and overlay surfaces.

1. Straightedge: The Engineer will check PCC pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than 1/4 of an inch in 10 feet will be marked. Complete surface corrections according to the procedures in Iowa DOT Section 2316 to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straightedge. Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

2. Profilograph:

a. If specified in the contract documents, comply with Iowa DOT Section 2316 to measure pavement smoothness with a profilograph.

b. Evaluate according to the smoothness requirements of Table 7010.04 and make surface corrections and price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

Table 7010.04: Pay Factor if Profilograph Used

Segment Index (inch/mile)	Pay Factor
0 - 22.0	100%
22.1 - 30.0	97%
30.1 and over	Grind as directed by Engineer

c. Smoothness measurements will be suspended for structures and through intersections.

D. Pavement Thickness:

1. At locations determined by the Engineer, cut samples from the pavement by drilling with a core bit that will provide samples with a 4 inch outside diameter. Restore the surface by tamping low slump concrete into the hole, finishing, and texturing. The Engineer will witness the core drilling, identify, and take possession of the cores. The Engineer will determine the core locations, measure the cores, and determine the thickness index according to Iowa DOT Materials I.M. 346 and 347, except as modified as follows:
   a. For regular or irregular shaped areas, use a lot size of 1,000 square yards. Include remnants less than 500 square yards in the last lot and remnants greater than 500 square yards in a separate lot. Take a minimum of three cores per project.
   b. For any core with a deficiency greater than 0.15 inch, take two additional cores in that pavement lot and use the average of the three cores.

2. Coring of pavement or other work for thickness determination may be waived by mutual agreement for sections of the same design thickness less than 2,500 square yards.

3. Based on the thickness index determined by the Engineer, the pavement payment will be as shown in Tables 7010.05 and 7010.06.

4. If the thickness index deficiency is greater than 0.51 for pavements thinner than 9 inches or 0.91 for pavements 9 inches or thicker, the Engineer will study the extent and severity of the deficiency of the pavement areas. The Engineer will require one of the following based on a review on the level of deficiency, the amount of the payment penalty, and the estimated reduction in the design life of the deficient pavement:
   a. Removal and replacement of the deficient areas with pavement complying with the contract documents at no additional cost to the Contracting Authority.
   b. Completion of an agreement that provides a combination of an extended guarantee period and payment penalty and allows the deficient pavement to be left in place.

Table 7010.05: Pay Factor for PCC Pavement for Design Thickness less than 9"

Thickness Index Range	Percent Payment
More than 0 to -0.15	100
-0.16 to -0.25	95
-0.26 to -0.50	85
-0.51 or less	As determined by the Engineer

Table 7010.06: Pay Factor for PCC Pavement for Design Thickness 9" or Greater

Thickness Index Range	Percent Payment
More than 0.00 to -0.15	100
-0.16 to -0.20	99
-0.21 to -0.25	98
-0.26 to -0.30	97
-0.31 to -0.35	96
-0.36 to -0.40	95
-0.41 to -0.45	94
-0.46 to -0.50	93
-0.51 to -0.55	92
-0.56 to -0.60	91
-0.61 to -0.65	90
-0.66 to -0.70	89
-0.71 to -0.75	88
-0.76 to -0.80	87
-0.81 to -0.85	86
-0.86 to -0.90	85
-0.91 or less	As determined by the Engineer

E. Defects or Deficiencies: Remove and replace or repair pavement containing excessive cracks, fractures, spalls, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer.

END OF SECTION

SECTION 32 9200

SEEDING AND SOIL SUPPLEMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Description of Work

B. Warranty

C. Seeding Dates

D. Seedbed Preparation

E. Seed Preparation

F. Application of Seed

G. Watering

H. Reseeding

I. Cleanup

J. Acceptance

1.02 DESCRIPTION OF WORK

A. Drawings and general provisions of contract, including general and supplementary conditions apply to this section.

B. This section shall include materials, equipment, and labor for the preparation of the seedbed, furnishing and installing seed, fertilizer and mulch, maintenance, and guarantee for completed seeded areas, as shown on plans. Seed all areas disturbed by construction, unless otherwise noted.

C. The Contractor shall use conventional seeding methods with hydro mulch; unless specified otherwise in the contract documents.

D. Provide permanent seed at the earliest possible date following grading and topsoil re-spreading and/or irrigation installation operations, as approved by Engineer.

1.03 PROTECTION OF PROPERTY

A. Protect existing conditions at the site against damage including the following:

1. Take precautions to insure that equipment, vehicles, and seeding operations do not disturb or damage existing grades, walls, drives, pavement, utilities, plants, lawns, irrigation systems, and other facilities.

2. Verify locations and depths of all underground utilities prior to excavation and report conflicts with new seeding operations.

3. Any damage to existing trees or shrubs, including branches and root systems shall be repaired and/or pruned by an experienced tree surgeon or arborist.

4. Contractor shall replace plantings damaged due to watering of newly seeded areas with same species, size, 1-year warranty, and planted as approved by Engineer without additional compensation.

5. All existing lawn areas undisturbed by construction within the construction limits shall be mown by the Contractor until the project is accepted.

6. New seeding installed adjacent to existing lawns shall be installed to provide a smooth matching grade transition in a straight, neat alignment as approved by the Engineer.

7. Repair, replace, and/or return to original condition any damaged item, without additional compensation.

1.04 SUBMITTALS

A. Submit a laboratory analysis showing the seed provided meets or exceeds the minimum requirements of purity and germination stated on an independent certificate of seed analysis document in accordance with the AOSA (Association of Official Seed Analysts) rules. The seed certification tag and seed analysis document provided must be from the same lot number as shown on the seed tag. The date of test results shall be no greater than 9 months from seed application date. The following information shall be included on the seed laboratory analysis:

1. Name of company responsible for analysis,

2. Lot number of seed being provided and tested,

3. Kind - Species or common name of seed. Include cultivar or variety name if applicable,

4. Seed origin,

5. Percentage of purity and germination,

6. Percentage of dormant seed,

7. Percentage of inert matter, other crop seed and weed seeds,

8. Restricted and prohibited noxious seed. Provide name of and number per pound of seed.

B. Submit from an established seed dealer or certified seed grower the applicable Association of Official Seed Certifying Agencies (AOSCA) certified Blue, Gold or Yellow Tag, from each container seed mixture dated within 9 months of delivery, indicating bulk weight of bag or container, percentage by weight and percentage of purity, germination and weed seed for each grass, forb, legume, and cereal crop stating botanical and common name of each species as specified in contract documents.

C. Submit certificates of inspection as required by governmental authorities and manufacturer's or vendor's certified analysis for soil amendments.

1. Certification of the fertilizer analysis with scale weight and statement of guaranteed analysis.

2. Certification of the tackifier ingredients, recommended rates of application, and expiration date.

3. Certification of the inoculant ingredient for legumes and the specific seed to be inoculated with the application rate and expiration date.

4. Certification of the fungicide ingredients and applicable fungus disease control and recommended application rate of manufacturer.

5. Certification on the sticking agent ingredients with applicable use and rate by manufacturer.

6. Certification in the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.

D. Submit written maintenance instructions recommending procedures for maintenance of seeded areas for one year, prior to final acceptance of the seeded areas.

E. Upon request the Contractor will provide additional Material Certifications to the Owner.

1.05 QUALITY ASSURANCE

A. All seed shall be certified and provided by an established seed dealer or certified seed grower.

B. All materials to be in accordance with Iowa Seed Law and Iowa Department of Agricultural Regulations and shall be labeled accordingly.

C. All materials and method of operation shall be subject to inspection and approval by Engineer.

D. Material not meeting requirements specified will be rejected.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Packaged materials shall be delivered in original, unopened, and undamaged containers.

B. Deliver, handle and store all materials according to product recommendations and protect them from loss, damage and deterioration.

C. Deliver all seed in original containers. Seed shall not be mixed or blended except in the presence of the Engineer.

1.07 SCHEDULING

A. Coordinate the seeding schedule with all other work on the project. Notify the Engineer at least three working days prior to the start of seeding operations.

B. After all land-disturbing activities are complete and the seedbed has been approved by the Engineer, perform seeding operations.

1.08 WARRANTY

The seeding shall be installed as specified to germinate and provide a uniformly dense stand of the seed mix specified, free of weeds and undesirable species, debris, and free of eroded areas and bare spots. Re-rake areas failing to show a good dense stand within 60 days and reseed as originally specified.

A. A warranty is to be provided for completed seeded areas, starting upon the date of initial acceptance. The warranty is to guarantee completed seeded areas to provide a uniformly dense, live, and healthy stand of seed mix specified, free of weeds and undesirable species, debris, and free of eroded areas, bare spots, diseases, and insects at the end of the warranty period of 60 days for domestic/lawn grasses and a 12-month period for native prairie and wetlands species from date of project acceptance.

B. During warranty period, any defects in the seeded area and grass stand such as weedy areas, eroded areas and bare spots shall be corrected and reseeded as originally specified until all affected areas are accepted by the Engineer, without additional compensation.

C. Repair and replace to original condition all damages to property resultant from the seeding operation and all damages as a resultant from the remedying of these defects, without additional compensation.

PART 2 - PRODUCTS

2.01 SEED

A. Provide fresh, clean, new crop, certified seed complying with tolerance for germination and purity and free of poa annua, bent grass, and noxious weed seed. Furnish all seeds, including grass, legume, forbs, and cereal crop seeds, from an established seed dealer or certified seed grower. All materials and suppliers are to follow Iowa Seed Law and Iowa Department of Agriculture and Land Stewardship regulations and be labeled accordingly.

B. Lawn Seed Mix: 90% Turf Type Tall Fescue with 10% Kentucky bluegrass mix.

Submit seed information sheet containing information outlined in section 1.04 A.

2.02 FERTILIZER

A. Fertilizer shall comply with the rules of the Iowa Department of Agriculture and Land Stewardship as follows:

1. The grade of fertilizer will be identified according to the percent nitrogen (N), percent of available phosphoric acid (P_2O_5), and percent water soluble potassium (K_2O), in that order, and approval will be based on that identification.

2. All fertilizer shall be furnished from an established fertilizer dealer and guaranteed percentage analysis shall be provided by the fertilizer supplier on each container with the proper scale weight records.

3. Fertilizer shall be of a type that can be uniformly distributed by the application equipment. Fertilizer may be furnished in a dry or liquid form.

4. When applied dry, the fertilizer shall be a granular, non-burning chemically combined product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Granular or pellet form shall be uniform in composition, dry, and free flowing without caking or other damage not suitable for use.

5. When applied in a liquid form, fertilizer may be chemically combined or may be furnished as separate ingredients.

6. Upon request of the Engineer, the Contractor shall provide a test of the fertilizer for conformance with the required analysis at no additional compensation; a tolerance of 1.0 percentage point plus or minus of that specified will be considered to be in substantial compliance.

2.03 WATER

A. Water shall be free of any substance harmful to seed growth.

B. The Contractor shall provide water, equipment, methods of transportation, water tanker, hoses, sprinklers, and labor necessary for the application of water.

2.04 MULCH

A. Hydraulic:

1. The material shall be a natural or cooked cellulose fiber processed from whole wood chips (no recycled material) which will disperse readily in water to form a homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit. Material shall be completely photo-degradable or biodegradable.

2. The homogeneous slurry of material and water shall be capable of being applied with standard hydraulic mulching equipment.

3. The slurry shall be dyed green to facilitate visual metering during application with said material or homogeneous slurry having no growth or germination-inhibiting factors, being completely non-injurious to plant or animal life and having no toxic effect when combined with seed, fertilizer, and water.

4. When applied, the wood cellulose fiber slurry shall be free from weeds or other foreign matter toxic to seed, consisting of a classification of fibers with a minimum of 30 percent having an average length of 0.15 inches or passing a Clarke Classifier 24 mesh screen, will form an absorptive mat, but not a plant-

inhibiting membrane, which will allow moisture to percolate into the underlying soil.

5. Mulch shall have a water-holding capacity of not less than 9 pounds of water per pound of fiber.

6. The wood cellulose fiber shall have an equilibrium air dry moisture content of 12 percent or less a time of manufacture, as defined by the pulp and paper industry standards, and shall have a ph range of 4.0 – 5.5.

7. It shall be packaged in new labeled containers and be applied at a rate of 1,800 pounds per acre (41.3 lb/1,000 sf).

8. The mulch shall include a colloidal polysaccharide tackifier which shall be adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing within the hydraulic mulching equipment.

9. The material shall be homogeneous within the slurry and shall have no growth or germination-inhibiting factors nor any toxic effect on plant or animal life when combined with seed or fertilizer. The material shall not form a water-resistant crust that can inhibit plant growth.

10. The tackifier shall be applied at a minimum rate of 50 pounds per acre (0.11lb/sq) and shall be packaged in new labeled containers.

11. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.

12. Straw or hay shall not be used as mulch.

2.05 INOCULANT FOR LEGUMES

A. An inoculant is a culture of bacteria specifically formulated for legume seeds (alfalfa, clovers, lespedesa, birdsfoot trefoil, hairy vetch, and crown vetch).

B. The manufacturer's container shall indicate the specific legume seed to be inoculated, rate of application, and the expiration date.

C. All inoculant shall meet requirements of the Iowa Seed Law. Follow the safety precautions specified on the product label.

2.06 FUNGICIDE

A. A fungicide shall be a noncommercial protectant formulation to provide protection from soil-born fungus diseases of seeds.

B. The application shall be made at the rate of 5 1/2 ounces of a 75 percent concentrate or equivalent per 100 pounds of seed.

2.07 STICKING AGENT

A. A sticking agent shall be a commercial material recommended by the manufacturer to improve adhesion of inoculant and fungicide to the seed.

B. For small quantities, less than 50 pounds, the sticking agent need not be a commercial agent, but it must be approved by the Engineer and must be applied separately prior to application of inoculant and fungicide.

PART 3 - EXECUTION

3.01 AREA OF SEEDING

A. Areas to be seeded shall conform to the limits stated or shown on the construction plans and contract documents. Areas disturbed outside the contract limits approved for seeding shall be seeded by the Contractor at no additional compensation.

B. Temporary Erosion Control: Contractor to provide and seed temporary seeding as may be required to fulfill NPDES Permit requirements.

3.02 SEEDING DATES

A. Seeding dates Lawn Seed shall be between March 1 to May 31 and between August 10 and September 30. Commence only when ground temperatures are 55 degrees Fahrenheit or greater.

B. Seeding dates for the Detention Basin mix shall be between April 1 and June 30. Commence only when ground temperatures are 55 degrees Fahrenheit or greater.

C. Dormant seeding for domestic lawn seed, if approved by Owner and Engineer, shall be completed when air temperatures are consistently below 40°F and prior to December 25 of a given year, unless otherwise approved. Dormant seeding is not allowed on snow. Prepare the seedbed before the ground freezes. To ensure protection of the seed, apply on a frosty morning or before a predicted snow. Application rate shall be 1.5 times the standard recommended rate.

D. Provide cover crop of Oats for stabilization over winter months if lawn seed is not installed by recommended seeding dates.

E. At the option and at the full responsibility of the Contractor, seeding operations may be conducted under unseasonable conditions. The final results shall be as specified and guaranteed without additional compensation should the seeded areas require reseeding.

3.03 SEEDBED PREPARATION

A. Limit preparation of seedbed to areas which will be seeded immediately upon completion.

B. Remove all straw-mulch, weeds and weed debris where weed growth has developed, in the opinion of the Engineer. Straw-mulch, weed growth and weed debris removal process shall be approved by the Engineer and shall be done without additional compensation.

C. Use crawler type or dual-wheeled tractors for seedbed preparation. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Harrow ridging in excess of 4 inches due to operation of tillage equipment prior to rolling with the cultipacker. Roll the area with no less than one pass of the cultipacker prior to permanent seeding.

D. The Contractor shall shape and fine grade to remove washes or gullies, water pockets, and irregularities to provide a smooth, firm, and even surface true to grade and cross-section.

E. Disk or rototill and cultivate seedbed to a minimum 3 inch depth to a fine texture and without soil lumps. Where the area is inaccessible to machinery, it shall be prepared by

hand to a minimum depth of 2 inches after the fertilizer has been applied. For lawn seeding areas, prepare to a fine texture and without soil lumps. Coordinate preparation of all ditches designated for special ditch control with the seedbed preparation. Till parallel to the contours.

F. Smooth the seedbed with a cultivator-type tillage tool having a rake bar or a rock rake. Pick up and remove all debris, such as rocks, stones, concrete larger than 2 inches (1/2 inch maximum for lawn seeding areas), or roots and other objectionable material that will interfere with the seeding operation. A spring tooth cultivator may be used in lieu of a rock picker. Remove the rock by hand after each use of the cultivator; repeat the process until the soil is relatively free of rock as determined by the Engineer.

G. Choose equipment to minimize soil compaction. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Roll the area with at least one pass of the cultipacker. Remove ruts that develop during the sequence of operations before subsequent operations are performed. This must be completed just prior to seeding and the work approved by the Engineer before the seeding application.

H. Application of Fertilizer:

1. Apply fertilizer after shaping and fine grading and prior to the combined tillage and rock-removal operations. On areas inaccessible to machinery, the fertilizer may be spread prior to tillage and cultivated seedbed preparation and uniformly mixed into the top 1 1/2 inches of soil.

2. Fertilizer shall be spread with a mechanical spreader or sprayer uniformly to all areas to be seeded at the minimum rate specified herein. The fertilizer shall be tilled into the soil to a minimum depth of 3 inches.

3. The Contractor shall be permitted to substitute other fertilizer containing analysis percentages different from those specified, provided that the minimum amounts of actual nitrogen (N), phosphate (P), and potash (K) per acre are supplied and that in no case shall the total amount per acre of the three fertilizer elements (N), (P), or (K) be exceeded by 30 percent of the following minimum amounts.

4. Conventional Seeding (Lawn Seed Mixes Only):

   a. Apply 6-24-12 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) at the rate of 200 pounds per acre. A minimum of 40 percent of the total nitrogen (N) shall be water insoluble nitrogen.

5. Tilling:

   a. After fertilizer has been applied, a mechanical rock picker shall be used on areas accessible to machinery to mix fertilizer in the soil to a depth of 3 inches and to remove all rocks, debris, and solid non-soil material larger than 1 inche in diameter from the upper 3 inches of the soil. A spring tooth cultivator may be used in lieu of a rock picker. The rock shall then be removed by hand after each use of the cultivator--the process to be repeated until the soil is relatively free of rock as determined by the Engineer.

   b. Remove all rock remnants from rock piles used on project smaller than 1 inch.

c. The seedbed shall then be smoothed with a cultivator-type tillage tool having a rake bar-such as the Roseman rake-or a rock rake-such as the York-gauged by rear gauge wheels or by a blade gauged by a landscape roller-such as the Viking roller blade.

d. Tilling shall be parallel to the contours.

e. Ruts and wheel tracks in the seedbed from seedbed preparation are to be removed prior to seeding. This must be completed just prior to seeding and the work approved by the Engineer before the seeding application.

3.01 SEED PREPARATION

A. Treat all legume seed with a commercial sticking agent to be applied prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials. A sticking agent is not required if a liquid formulation of inoculant is used. Use mechanical mixing equipment to apply sticking agent and inoculant on seed quantities over 50 pounds.

B. Inoculate all legumes with a standard product humus culture before being mixed with other seeds for sowing.

C. Inoculate all legumes with a standard culture at the rate specified by the manufacturer of the inoculant according to Iowa DOT Article 4169.04. Do not expose inoculated seed to direct sunlight for more than 30 minutes. Re-inoculate seed that is not sown within 8 hours after inoculation prior to use. Pre-inoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor-applied inoculant.

D. When the gravity or cyclone seeder is used for application of seed, inoculate legume seed according to the manufacturer's recommended procedures, before mixing with other grass seeds for sowing. Furnish and apply inoculant.

3.02 APPLICATION OF SEED

A. Prior to seeding, the seedbed shall be inspected and approved by the Engineer and Owner.

B. Conventional Seeding:

6. Sowing:

a. Domestic Grasses - On all areas accessible to machinery, all grasses shall be sown with a drop-type seeder attached to a landscape roller in such a manner that the seed is applied and then covered by rolling which firms the soil. Seeding to be completed with a minimum of two passes in different directions.

b. On areas inaccessible to field machinery, the use of cyclone seeders will be permitted, but no other hand-seeding methods will be accepted.

7. Hydraulic Mulching:

a. Hydraulic seeding is not acceptable.

b. All material, fertilizer, mulch, tackifier, and fungicide shall be placed in hydraulic-mulching equipment specifically manufactured for hydraulic mulching.

c. Materials shall be mixed with fresh potable water using a combination of both recirculation through the equipment's pump and mechanical agitation to form a homogeneous slurry.

d. It shall be applied evenly over all specified areas in a workmanlike manner at component material rates specified.

e. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.

f. Site cleanup shall be considered part of application and shall include the removal of hydraulic mulch slurry from buildings, landscaping, fencing, sidewalks, and any other areas not specified for application. All debris resulting from this application shall be removed from the site.

3.03 WATERING

A. All seeded areas shall be kept moist at all times. The areas shall be artificially watered a minimum of twice a day (early morning and evening) every day for the first week after seeding is completed.

B. For the second and third weeks after seeding, the seeded areas shall be artificially watered once a day (early morning or evening).

C. The quantity of water used shall be adequate to keep the soil and mulch moist to a depth of 1 inch and ensure growth of the seed. If natural rainfall is adequate to keep the soil and mulch moist as stated above, artificial watering may be deleted.

D. Any area seeded in the month of May shall be maintained for an additional 3 weeks. The seeded areas shall receive a minimum of 1 inch of water each week (either natural, artificial, or combination) for the fourth, fifth, and sixth week after seeding.

3.04 MAINTENANCE

A. Domestic Grasses - Maintenance shall begin immediately following the installation of seed and mulch and continue for a 60 day period from project acceptance.

B. Maintenance of seeded areas shall include protection against traffic, repairing of areas damaged, watering, rolling, and mowing when grasses are at an approximate 3-inch height.

1. If areas are seeded in the fall and not given a full maintenance period, or if seeding establishment is not acceptable at that time, continue maintenance the following spring until acceptable lawn area is established.

3.05 RE-SEEDING

A. When all work related to seeding on an area has been completed but is washed out or damaged prior to final acceptance of the seeding area and that area involves seeding in combination with mulching or fertilizing or both, the area shall be reseeded, refertilized, and remulched at the contract unit price or prices when so ordered by the Owner.

B. Fertilized or seeded areas damaged by rain prior to required mulching or areas where the mulch is not tucked shall be refertilized or reseeded or both at a rate not to exceed the specified rate, as designated by the Engineer, without additional compensation.

3.06 CLEANUP

A. Perform cleanup operations during installation of work and upon completion.

B. Remove from site all excess materials, debris, and equipment.

C. Hose down and/or broom clean all paved surfaces.

D. Repair any damage resulting from seeding operations.

E. Remove hydraulic slurry from buildings landscaping and plantings, mulch, sidewalks, pavement, and any other areas not specified for application.

3.07 FINAL ACCEPTANCE

A. The areas seeded shall be given acceptance based upon the following criteria:

1. All requirements for the completed installation and a minimum of 60 days maintenance have been provided for domestic grasses.

2. Seeded areas shall be in a live, healthy, growing, and well-established condition without eroded areas, bare spots, free of weeds, undesirable grasses, disease, or insects.

3. Re-seeding operations are completed, as per original specifications.

B. Final acceptance may be given by the Owner upon fulfillment of all items completed as required.

END OF SECTION